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THE SHATTUCK LECTURE.*

ENERGY REQUIREMENTS OF CHILDREN FROM BIRTH TO PUBERTY.

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OF the innumerable measures for conservation instituted as a result of war, it is probable that none will be more effectively and universally retained than those conserving child life. The recent International Red Cross Congress at Cannes, participated in by my colleague, Dr. Fritz B. Talbot, is but an expression of the intense interest shown by all economists and physicians, not only in the retention of existing agencies for the betterment of child life, but in the elaboration of further plans to this end.

With no desire to minimize the enormous significance of prenatal care, the importance of breast feeding, and of the best hygienic conditions both for mother and child before and after birth, perhaps the most important factor in the life of the child after it has been weaned is the quality and quantity of its food. While it has long been clinically established that milk is a necessity in the diet of the child, it is only in recent years that modern investigators have scientifically explained this fact by showing that certain food accessories, popularly termed "vitamines," are best served to the growing child in the form of milk. So far as the quantity of food is concerned, we now know that appreciable amounts of protein, fat, and carbohydrate are necessary, but for our present consideration we can lay more emphasis upon the total caloric content of the food ingested.

Computations and estimates of the heat value of the food intake made with individual children, while of considerable significance and of great help during the earliest years of life, are usually so scattered and unfortunately so individualistic as to prevent any but the grossest generalization. For an intelligent understanding of the laws governing the vital activity of children, fundamental observations of physiological factors, determined in a large number of instances in special laboratories, are essential.

Food is needed for two main purposes, first to supply the energy requirements for maintenance or, in common commercial parlance, the "overhead charges" of running the organism or little machine, and second, to provide the very substantial additions thereto needed for the large amount of muscular activity of the growing child. Physiologists have long recognized that the maintenance cost is of prime importance in a comparison of the normal values for energy requirements for individuals of all ages. The

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measurement of the heat produced by a child or adult as a result of oxidation and the transformation of energy has now become a matter of laboratory technique. The details of such measurement have long been satisfactorily developed and we now await only the amplification of observations on individuals for the making of intelligent group averages.

The Nutrition Laboratory has been occupied for the past decade or more in the study of the heat production of humans from birth to old age. For a number of practical reasons the largest number of subjects studied have been of the so-called college student age, since such students were available as both volunteer and paid subjects. A number of years ago it was proposed that a study be made of the energy requirements of normal children, Dr. Fritz B. Talbot volunteering to coöperate in such an investigation. Thanks to the officials at the Massachusetts General Hospital, particularly Dr. F. H. Washburn, opportunity was given for the establishment there of a respiration laboratory, thus making possible a study of the heat production of children under two years of age.[1] As time went on, it was seen that we could not rely upon the ordinary hospital population for distinctly normal material, as presumably the last place to which a normal healthy child would go is a hospital. Arrangements were made to obtain a large number of new-born infants from the Boston Lying-In Hospital and a sufficient number of these infants were studied to establish thoroughly the basal metabolism or heat production of children immediately after birth and up to 8 days of age.[2] To extend these fundamental observations by studying children 8 days and older has been the object of our coöperative investigations for a number of years past and we now have data covering the period from birth to puberty with both sexes.

The method of measuring the heat production of the child deserves more than passing notice. To make the presentation of our results this evening more intelligible, may I refresh your memory on a few of the fundamental facts pertaining to the measurement of heat production.

When material is oxidized in the body, carbon dioxide is given off, oxygen is consumed, and heat is produced. These processes go on irrespective of whether food is taken or not, for the fasting organism during the first few hours of fasting shows no appreciable diminution in heat production. The direct measurement by a calorimeter of the heat given off by an individual represents, perhaps, one of the most complicated processes in the physiological laboratory. Fortunately, by means of standard, well-established figures, it is possible to compute with great accuracy the amount of heat produced if one knows the amount of carbon dioxide produced and the amount of oxygen consumed; consequently, for a large portion of modern experimental work upon the metabolism of children, only the accurate measurement of the carbon dioxide produced and oxygen consumed is essential.

The processes of combustion in the body are augmented principally by two factors. The ingestion of food *per se* calls for an increase in heat output which, with adults, may be very considerable. This increase in heat production has had many explanations but we believe it to be due to the fact that the products of digestion, probably of an acid nature, have a stimulating effect upon the cells, thus causing greater cellular activity. Such increase in heat production may for a short time rise to 50 per cent. of the normal resting metabolism without food in the stomach. Of far greater influence upon the heat production, however, is muscular activity in any form. This may, in the case of hard-working adults, amount to 1,000 per cent., or 10 times the normal heat production.

For heat measurements to be comparable, not only with adults but with infants and older children, it was soon found that they must be made as nearly as possible under comparable conditions, *i.e.*, with complete muscular repose and, if practicable, without food in the stomach. Under these conditions the heat production measured is termed the *basal* metabolism and is quite synonymous with the overhead charges of the commercial world, *i.e.*, the cost in calories for running a machine when no external work is performed. It is not necessary to have productive work performed in order to increase the heat production. Thus crying increases the metabolism of a child very greatly over that of a perfectly quiet infant. One can easily see that for physiological control it would be utterly impossible to compare the metabolism of a restless, crying, normal infant with that of a weak, sick, emaciated child, remaining perfectly quiet.

In the last analysis, measurements of the normal metabolism are most useful to the clinician, at least, for comparative purposes. Such measurements may show whether a specific disease, or the application of therapeutic measures changes or modifies in any way the vital activities of the child as expressed in the sum total of its heat output, since the total heat production may be looked upon as the resultant of the activities of the entire organism. Until the probable normal heat production is known, the measurements in disease can have no particular significance or, indeed, real interest. Fortunately Dr. Talbot early recognized the importance of not entering into the more attractive field of the study of abnormal and pathological conditions but realized that the greatest service, not only to physiology and pediatrics but, indeed, to pathology, could best be rendered by a careful survey of the energy requirements or caloric output of perfectly normal children measured under such conditions as to make the results perfectly comparable, other things being equal, with the energy requirements of sick children. I would emphasize again the fact that we have here the rare case of a clinician who has recognized the fact that normal physiological data are, in the long run, of greater value to medicine as a whole than scattered observations of pathological cases could have, most interesting as these latter would be.

Our problem, then, was to measure the minimum heat production, the basal metabolism, the cost of maintenance, the overhead charge expressed in terms of heat, of children from birth to puberty, employing for this purpose the method of indirect calorimetry, *i.e.*, the computation from the carbon-dioxide production and oxygen consumption of the number of calories of heat produced. To insure perfectly comparable conditions, it was necessary for us to demonstrate that we were dealing with children in repose, and consequently our apparatus was so designed as not only to measure directly the carbon dioxide and oxygen but to give a graphic record proving beyond doubt the quietness of our subjects.

To study the gaseous metabolism of infants, *i.e.*, the carbon dioxide produced and the oxygen consumed, we employed a small metal chamber with a quickly removable cover fitting down into a water seal to make it air tight, and connected the chamber with a suitable ventilating device permitting the withdrawal of carbon dioxide from the chamber and the introduction of pure oxygen to take the place of that absorbed by the child. The schematic design of the apparatus is shown in Figure 1, in which it is seen that the pump removes air from the respiration chamber, passes it through an absorbent for water (usually strong sulphuric acid), and afterwards through an absorbent for carbon di-

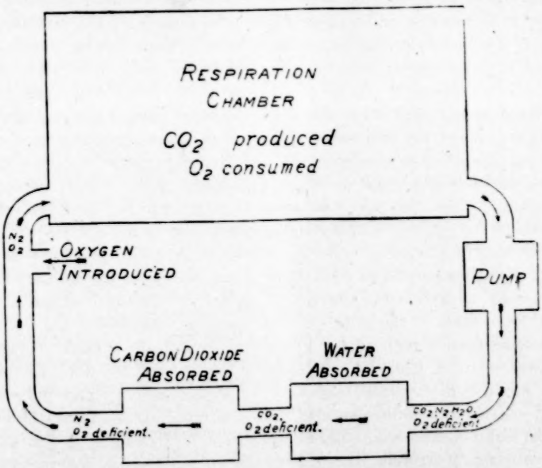

FIG. 1.—Schematic outline of infant respiration apparatus.

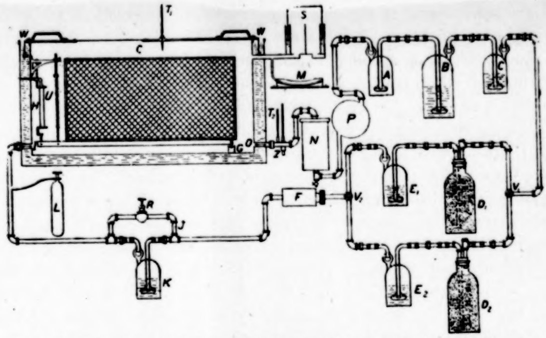

FIG. 2.—Detailed scheme of infant respiration apparatus. *C*, chamber; *W*, *W*, water jacket; *O*, outgoing air-pipe; *Z*, psychrometer; *N*, muffler; *P*, blower; *A*, acid trap; *B* and *C*, Williams water absorbers; V_1 and V_2, two-way valves; D_1 and D_2, carbon-dioxide absorbers; E_1 and E_2, air dryers; *F*, sodium bicarbonate can; *J*, by-pass; *R*, valve; *K*, air-moistener; *L*, oxygen cylinder; *I*, ingoing air-pipe; *S*, spirometer; T_1 and T_2, thermometers; *M*, manometer; *U*, spiral spring; *H*, pneumograph.

oxide (soda lime); the air is then returned to the chamber after pure oxygen has been introduced from a cylinder of the compressed gas. The total amount of carbon dioxide given off by the child can be obtained directly by weighing the absorbing vessels. The amount of oxygen introduced can be directly metered on a good gas meter.

A somewhat more elaborate scheme is given in Figure 2, in which is seen the water-jacketed chamber, the blower, the several water absorbers and soda lime cans in series, the small expansion chamber or spirometer, and particularly the suspension of the inside crib which makes possible a record of the muscular activity. The latter feature is better shown in Figure 3. As the baby is placed in the crib with the head toward the left, one end of the crib rests on the knife-edge bearing, the other is suspended by a spiral spring. Parallel to the spiral spring is a small pneumograph which in turn connects through the walls of the chamber and through a piece of rubber tubing to a tambour and a small pointer which is directly adjusted to write upon the smoked paper on the drum of a kymograph. Any change in the location of the child's centre of gravity alters the tension both of the spring M, and the pneumograph N, thus expanding and contracting the air in N and, in turn, the air in the tambour P, causing the pointer to rise and fall. When the baby is absolutely quiet, the pointer draws a perfectly straight line; when a movement occurs, this is instantly registered by the pointer. Indeed, it is not uncommon for the slight movements due to respiration, the rise and fall of the chest wall, to be recorded with great regularity on the drum.

A typical picture of a complete kymograph curve is given in Figure 4. It will be seen from this record that for a considerable time after the infant was placed inside the chamber, there was great activity and it was not for approximately 1½ hours that the child became adjusted to the conditions and fell asleep. Thereafter the line is almost unbroken. As we have already stated, metabolism measurements must be made during complete muscular repose, otherwise they have no value for comparative purposes; hence only those observations during the latter part of the period shown by this curve are of value for comparison.

Simultaneously with the records of activity, frequent pulse counts were made by the attendant nurse. The instant response of the pulse-rate to muscular activity is shown in Figure 5, in which the curve for the pulse-rate is compared with the kymograph curve for the activity. The two curves show that when the pulse-rate reached a level, the kymograph line was practically straight. Taking into consideration, therefore, the physiological factors of muscular activity and pulse-rate, we have two admirable checks upon the basal, quiet condition. Accordingly, if we restrict our measurements of the basal metabolism to periods simultaneous with a low pulse-rate and an absence of

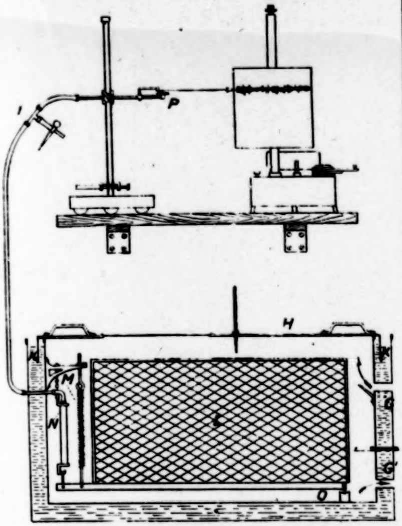

FIG. 3.—Method of obtaining graphic record of muscular activity. *L*, crib; *O*, knife-edge support; *M*, spiral spring; *N*, pneumograph; *P*, tambour; *T*, tee for equalizing tension; *H*, cover of apparatus; *K*, water bath; *G*, ingoing air-pipe; *G'*, outgoing air-pipe.

activity, we are reasonably certain that we are on the proper fundamental basis.

This apparatus for measuring the gaseous metabolism of infants, with the provisions just illustrated for graphically recording the degree of muscular repose, was installed in the Massachusetts General Hospital as shown in Figure 6. It was placed in charge of Miss Alice Johnson of the Nutrition Laboratory staff, whose fidelity and continued interest in the work made the collection of much of our earlier material possible.

This respiration apparatus was used at the Massachusetts General Hospital for about two years; but after the accumulation of data with regard to new-born infants, we sought normal children up to two years of age. Recognizing again that the last place in which normal children could be found was in a hospital, we made arrangements with the Directory for Wet Nurses for such observations. A room was assigned and facilities were provided for studying children from two weeks to two years of age, the children all being the offspring of registered normal wet-nurses and hence an unusually good type of physical normality.

The equipment used is shown in Figure 7, the apparatus being removed to another place for the purposes of photography. The chamber is shown in the immediate foreground, with the kymograph and pointer, the thermometers through the cover, and the ventilating pipes leading to and from the chamber. The small expansion chamber or spirometer is on the right hand end of the table. The white carbon-dioxide absorbing bottles containing soda lime are on the extreme left, while the motor, blower, and water-absorbing bottles are on the lower shelf. In the rear is the ga smeter through which the oxygen is passed and upon which it is measured. The whole operation is one that proceeds with great regularity and simplicity when the technique has once been developed.

It is not, however, with the technique of the observations that we have especially to do, for interest in this is more particularly confined to special laboratories in which such observations are made. Although we have frequently noted that the method of study is not without interest to clinicians visiting the institutions in which we have worked, the results of the observations and the method of computing the values obtained by this technique are of more general interest.

TABLE I.—COMPARISON OF INFANTS' PULSE-RATE AND GASEOUS EXCHANGE DURING PERIODS OF QUIET AND MUSCULAR ACTIVITY.

SUBJECT AND CONDITION		WEIGHT	AV. PULSE-RATE PER MINUTE	CARBON DIOXIDE PRODUCED PER HOUR	OXYGEN CONSUMED PER HOUR	HEAT PRODUCED PER HOUR
		kgm.		gms.	gms.	cals.
Infant (E. N.)	asleep	5.41	114	4.81	4.40	14.7
	awake	5.45	114	5.52	4.58	15.6
	crying	5.38	136	6.74	5.63	19.3
Infant (E. H. S.)	asleep	3.15	103	3.20	2.54	8.8
	awake	—	112	3.68	3.25	10.1
	restless	—	119	4.38	3.30	12.0
Infant (O. C.)	5 hrs. old	3.64	111	2.11	1.98	6.6
Infant (U. H.)	3 hrs. old	4.08	103	2.42	2.04	7.0

By weighing the carbon-dioxide absorber, the amount of carbon dioxide produced in periods of 20 or 30 minutes, depending upon the length of the experimental period, can be exactly determined. By means of a system of valves, the air current can be diverted at the end of the experimental period into a new set of absorbers, and observations made in consecutive periods *ad libitum*. Usually the length of the period is determined solely by the degree of repose of the subject. The oxygen consumption is read directly from the gas meter, the pulse is counted fre-

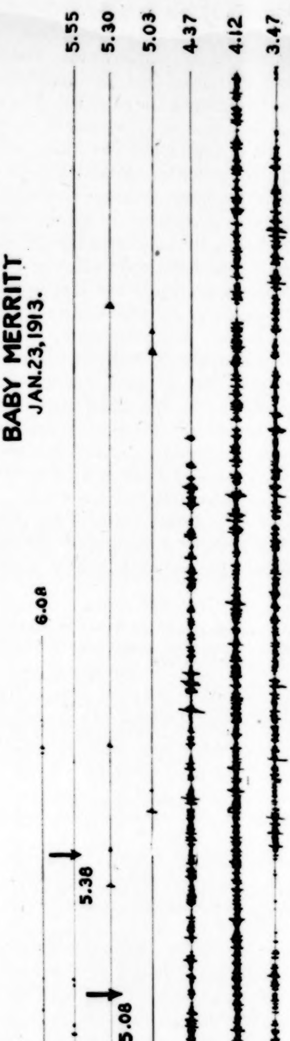

FIG. 4.—Typical kymograph curve showing degree of muscular repose of infant.

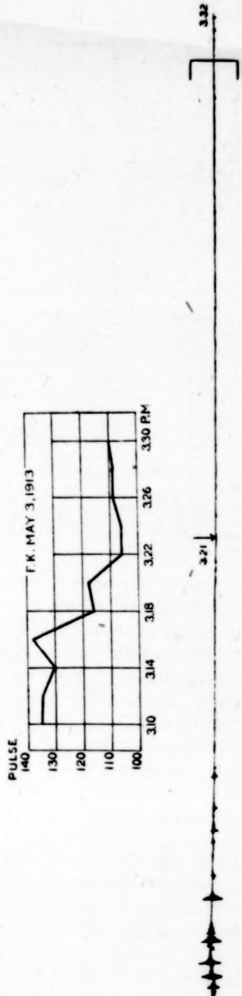

FIG. 5.—Comparison of curves for pulse-rate and muscular activity of infant.

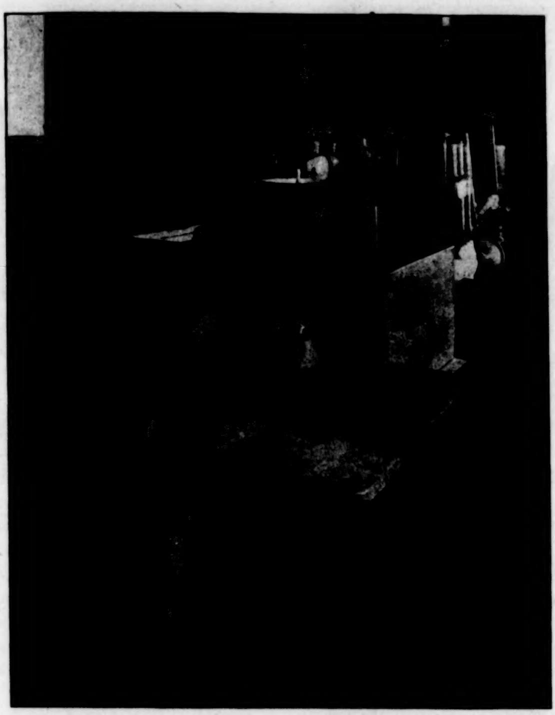

FIG. 6.—Infant respiration apparatus as installed in the Massachusetts General Hospital. In the foreground is the respiration chamber, with crib inside. The cover of the chamber rests on the floor, and through the glass window may be seen the earpieces of the stethoscope used for recording the pulse-rate. On the shelf in front of the chamber are the tambour and kymograph for graphic records of movements. Back of the chamber are the air-purifying vessels.

quently by the nurse, and the degree of muscular repose noted from the kymograph. From the measurement of the oxygen consumption and the carbon-dioxide production, a simple calculation gives the amount of heat produced per hour. A comparison of the heat production, oxygen consumption, carbon-dioxide production, and pulse-rate is then possible. Such a comparison is shown in Table I, in which the influence of activity, like that of crying, is clearly exhibited. As is well known, it is impossible for an infant to remain quiet when awake and hence we note with these infants an increment in all factors when they are awake as compared with the observations when they are asleep. The amount of restlessness determines the increment due to activity.

With the particular children here shown, crying produced an increment in the metabolism of about 33 per cent. Our records show, however, increments very much greater. Thus we find with so weak an organism as the new-born infant, who is obviously incapable of external muscular work, we have numerous records with an increase in the metabolism, due to crying and other activity, of as much as 200 per cent. above the minimum value. Indeed, when the *maximum* heat output of 93 subjects, as obtained in the periods of greatest activity recorded on the kymograph, was compared with the *minimum* heat output, it was found that the average increment was 65 per cent., while increments of 100 per cent. or over were at times found with 10 of the infants. This alone is sufficient to emphasize the importance of complete repose for results of comparable value.

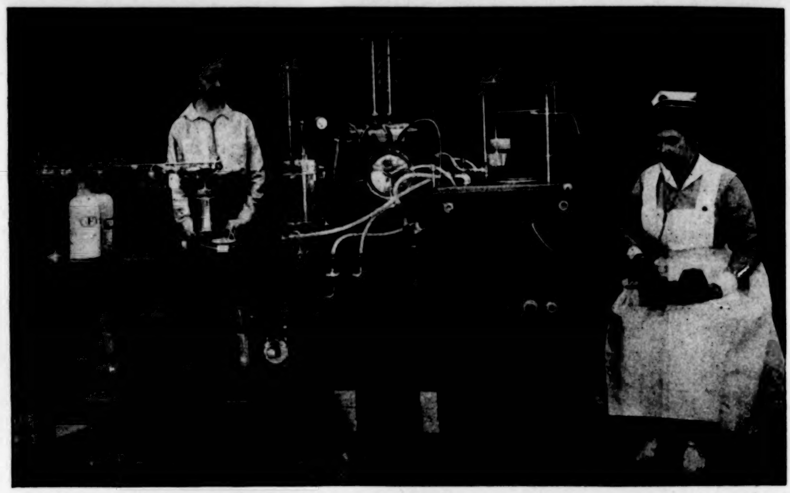

FIG. 7.—Infant respiration apparatus as used at the Directory for Wet Nurses. At the right are the respiration chamber, the tambour and kymograph for recording the muscular activity, also nurse counting pulse-rate. At the left is the absorbing system, with the carbon-dioxide absorbers and spirometer on the upper shelf of the table, the water-absorbers and blower on the lower shelf. The gas meter for measuring the oxygen may be seen in the center.

Two new-born infants are included in table I and show, as noted in the last column, a very low heat production. It is not, however, with individual cases of this type that we have particularly to deal, for with 100 new-born infants, one can readily draw general conclusions. One question of importance is: What is the average pulse-rate of new-born infants? Since with new-born infants no evidence of sex differences in metabolism has ever been observed, we may average all records. The average pulse-rate during the periods of minimum heat production is shown in Table II. It is here seen that the average pulse-rate of children slowly rises during the first 8 days of life.

TABLE II.—AVERAGE PULSE-RATE OF INFANTS DURING PERIODS OF APPROXIMATE MINIMUM HEAT PRODUCTION IN FIRST EIGHT DAYS AFTER BIRTH.

DAY	PULSE-RATE
First	112
Second	114
Third	116
Fourth	116
Fifth	116
Sixth	122
Seventh	119
Eighth	126

In connection with our experiments rectal temperatures were invariably taken at the beginning and end of experiments and no child with the slightest evidence of abnormal temperature was used for observation purposes. The temperatures practically all ranged within very narrow limits. The pronounced effect of the bath upon the new-born infant, which may be seen in Table III, is rather striking.

TABLE III.—RECTAL TEMPERATURE OF AN INFANT, TAKEN AT FREQUENT INTERVALS DURING EARLY HOURS AFTER BIRTH.

(Temperature of room, 71° F.)

TIME	RECTAL TEMPERATURE ° F.	
4.01 P.M.	Birth	
4.06 P.M.	98.6	
4.17 P.M.	98.6	
4.20 to 4.45 P.M.	Bath	in water 102° F., after oiling
4.46 P.M. (?)	97.6	
4.56 P.M.	95.4	(Put in respiration chamber, well clothed)
5.23 P.M.	95.4	
5.49 P.M.	95.8	
6.17 P.M.	96.2	
6.44 P.M.	96.8	
7.09 P.M.	96.8	
7.34 P.M.	97.4	
7.59 P.M.	97.4	
8.25 P.M.	97.6	
8.50 P.M.	97.6	

This sub-normal temperature of new-born infants and the imperfectly developed temperature regulations were clearly reflected in the values found for the heat production on the first day of life, for if we take the heat production as computed for the 24 hours and compare it with the age in the first week of life, we note

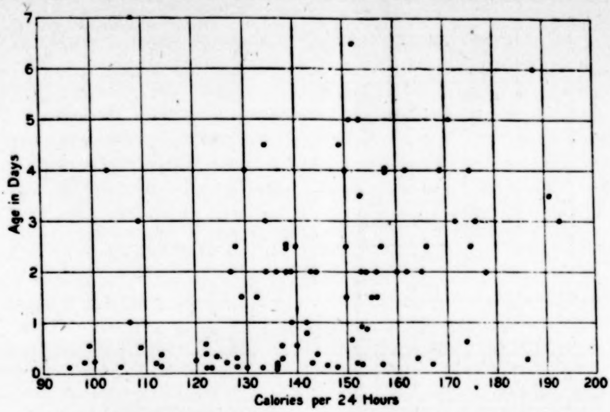

FIG. 8.—Minimum heat production of new-born infants per 24 hours referred to age.

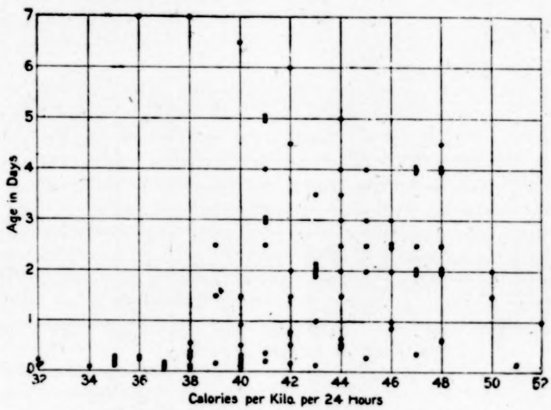

FIG. 9.—Minimum heat production of new-born infants per kilogram of body-weight per 24 hours referred to age.

that practically all of the low values occur on the first day. (See Figure 8.) A careful analysis of the heat production after the first day of life showed much more general regularity.

Since the babies varied somewhat in weight, the heat production referred to the body-weight is of interest. By computing the heat output per kilogram of body-weight, we find the children on the first day of life likewise tend to have the lowest values. (See Figure 9.)

It is commonly believed (although probably no one factor has done more to disturb this deduction than has the measurement of these identical babies) that the heat production of warm-blooded animals is exactly proportional to the surface area, a round number of 1,000 calories per square meter of surface area being that most commonly considered as the 24-hour heat production. We have computed the basal metabolism of these infants during the first 8 days after birth and find *average* values very much lower than the hypothetical 1,000 calories, these ranging from 592 calories on the first day to 702 calories on the eighth. The *individual* values (see figure 10) range from 460 to 732 calories per square meter per 24 hours. Here again we

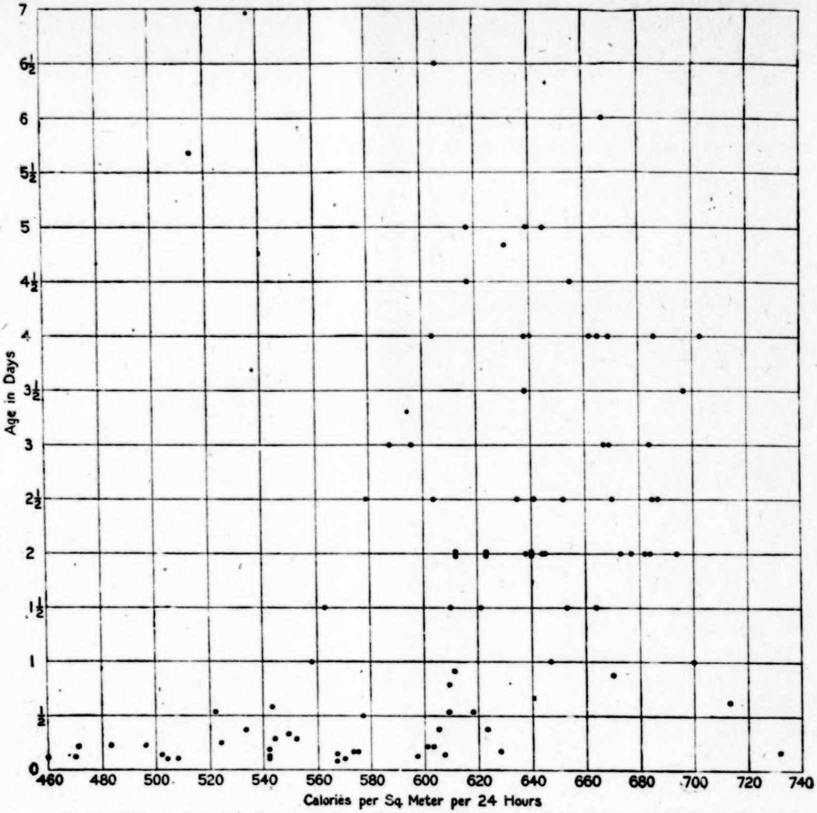

FIG. 10.—Minimum heat production of new-born infants per square meter of body-surface per 24 hours referred to age.

see a disturbance on the first day of life due, we believe, to the imperfect development of the mechanism for temperature control. From the average of 94 subjects during the first week of life, we found that the heat production per square meter of body surface is 612 calories and per kilogram of body weight 42 calories, while the total basal heat produced per 24 hours by the new-born infant is 143 calories.

As previously stated, from an analysis of all of our measurements for male and female new-born infants, it is very clear that there is no differentiation as to sex and consequently we may apply our standard average values to both boy and girl babies. In summation, then, we may say that the pulse-rate of a new-born baby is, on the average, 112 per minute, when the child is resting quietly. The heat production is 143 calories per day, or about one-tenth that of the average woman. The heat production per kilogram of body-weight is 42 calories, and the heat production per square meter of body surface is 612 calories. These data are fundamental and make possible all subsequent comparisons with new-born infants.

Whatever interest the physiology of the new-born may have to the pediatrician, much more general interest is to be found in the study of the energy requirements and physiological activities of children during the process of growth. It has been pointed out that growing children present most unusual conditions for studying the

physiological variations in the normal organism, for the period of a few months in the child's life results in more metamorphoses than periods of corresponding years in adult life. During the period of rapid growth, the food intake must supply not only the maintenance heat, *i.e.*, the overhead charge, but it must supply material for growth, addition of tissue, and replacement of tissue; and finally, the extraordinary activity of growing children calls for a proportionately very large energy intake.

Deferring for the time being a consideration of the two energy factors for growth and physical activity, we can properly study the basal requirements of growing children and determine them under such conditions of repose and absence of digestive activity as to make them comparable not only with each other but with the values that we have already determined for new-born infants and likewise for the well-established series of normal adults.

Two methods of studying growing children suggest themselves. One is to study relatively large numbers of infants of different sex, age, height, and weight; in other words, by studying *individuals* and comparing the average values found, we may note the influence of age, height, weight, and sex upon the heat production. This necessitates at least two experiments with each subject but to be of value requires a large number of subjects.

The other method—obviously the most difficult—is to study the same individual over a longer period of time, months, if not years. To retain such control of children as to have them available for metabolism experiments during a considerable period of time presents many difficulties. Thanks to the untiring energy of Dr. Talbot, we have been able to include in our series some 25 children who have been studied over periods ranging from several months to three or four years. Since the children of wet-nurses studied at an early age frequently are farther and farther dispersed as time passes, making a periodic round up for observations increasingly difficult, we are fortunate in having attacked the problem from *both* standpoints.

When we consider that the ideal conditions for a study of the metabolism are complete muscular repose and no food in the stomach, it is at once evident that the latter condition especially is not easy to secure with young children, for in the normal state the growing child has more or less food in the stomach, particularly in the earlier years. It should be stated at the outset, therefore, that in many of our observations with young children it was necessary to include periods with more or less digestive activity. Special attention was given to this point in an attempt to quantify the influence of normal feeding upon the basal metabolism. The influence of different amounts of food upon the metabolism of adults is well known; our evidence implies that with children the influence is proportionately very much less, for apparently that quota of the food ingested which goes to the deposition of tissue does not participate prominently in the stimulation of the metabolism.

An ideal study of the energy requirements of children would be one, furthermore, in which children in all stages of nutrition should be included, both those distinctly overnourished as well as those who are undernourished. Believing that our best service to medicine would be to contribute to a more extensive knowledge of the strictly normal child, we have therefore laid special emphasis upon the normality of our subjects.

The consideration of what is normal in a child brings up immediately several difficult questions. An average or normal for adults, determined from large masses of data secured generally through life insurance companies, has been accepted by practically all statisticians and actuaries. For this purpose men and women have been averaged and grouped according to age, weight, or height, and the *average* adult, or so-called normal, has been taken as the normal standard. It is important to bear in mind, however, that this *average*, or so-called normal, includes individuals that deviate widely from the average. Thus, there is a large proportion of overweight men and women and likewise a large proportion of underweight men and women, but these two extremes tend to balance each other. We believe that in considering the *normal* for the growing child, a gross error has been committed in blindly accepting the *average* weight for height or age as normal. Contrary to the conditions with adults, the overweights among children do not counterbalance the underweights, for one has but to stand at the entrance of one of our public schools to note the relative rarity of obviously overweight

children and the great frequency of underweight children.

It has been a common custom to consider the weight for age as an index of the nutritional condition of the child. As a physiological and physical entity, this seems fundamentally erroneous, and we welcome Dr. Holt's recent discussion of this point. The weight for height seems much more logical. If the height is too small for the age, one may logically assume either that the child is the offspring of a family of normally short stature or one may suspect deficiency in the skeletal growth. On the other hand, a child may be of the normal or average height for the age and yet be definitely undernourished and underweight. In the first instance one may suspect deficiency in the skeletal growth and in the second instance, one suspects deficiency in caloric intake. If this reasoning be true, then obviously so-called normal curves for children are too low, for the *normal* on this basis, as we have seen, includes a much larger proportion of undernourished children than of overnourished children. Bearing this differentiation in mind in the analysis of the average weights for heights and weights for age of our children we have attempted to eliminate those who are obviously much below the so-called average or normal weight. Although certain underweights crept into our observations, owing to scarcity of material, the results obtained with them are not included in our discussion of normal data.

It is thus seen that to establish the exact normal weight of children is a matter of considerable difficulty, for it is clear from the foregoing discussion that the *average* is not *normal*. If we are to have better babies and better children, we believe that dietitians, physicians, and mothers should disregard entirely the misleading averages and strive for a condition of nutrition measurably better than that indicated by the so-called average or normal line. From the results of the Medico-Actuarial Investigation, it is clear that the probability of longevity is distinctly greater for young men and women who are overweight, *i.e.*, over the average weight, up to about 30 years of age. Beyond that age the reverse is true and excess flesh is detrimental to the probability of long life. While the Medico-Actuarial Investigation did not include individuals of the ages when the weight changes are rapid, it is reasonable to infer that if overweight is advantageous for young people from 18 to 30 years of age, overweight with children may in all probability be considered as advantageous.

The large amount of data resulting from our concentrated study of children up to two years, mostly breast-fed babies of wet-nurses, was obtained with subjects whose normality was satisfactorily established. Through the courtesy and keen appreciation of the superintendent of the New England Home for Little Wanderers, Dr. Frederic H. Knight, we were able to establish a laboratory in that institution for observations on children over two years of age. Investigations have proceeded with their more or less floating population of children for about two years and, at the moment of speaking, are still in progress.* But the population of even so admirably managed an institution as the New England Home for Little Wanderers must be considerably more heterogeneous in character than the babies of wet-nurses. Children are given excellent care in that institution and usually increase in weight, as not infrequently they are somewhat underfed previous to their entrance. And yet, making our selection as best we could, there still remains the fact that the subjects of these later observations more nearly approach the *average* than the *ideal*.

With increase in the size of the children studied, a somewhat larger respiration chamber was necessary; indeed, as the investigation progressed, it not infrequently happened that two sizes were used alternately. Finally a chamber sufficiently large to contain a child as old as 14 years was employed. In every instance the attempt was made so to adjust the experimenting as not to have the chamber disproportionately large for the subject observed.

The apparatus employed for studying the older children, which was installed in the special laboratory at the New England Home for Little Wanderers, is substantially a duplicate of the one used for normal babies, with the single exception of the fact that the chamber was much larger and hence of a somewhat different type of construction.† While with the babies the cover of the chamber shut down like the lid of a trunk, in this case the cover was of semi-

* The apparatus is under the skilful direction of Miss I. A. Boles of the Laboratory staff and the children receive most excellent care from Mrs. Dorothy A. Peabody, the nurse in charge.

† This apparatus is a small form of the clinical respiration chamber described by Benedict and Tompkins, Boston Medical and Surgical Journal, 1916, Vol. clxxiv, pp. 857, 898, and 939.

FIG. 11.—Infant respiration apparatus as used for children at the New England Home for Little Wanderers. The respiration chamber, with rounded cover and thermometers, is near the center of the picture, the absorber-table at the left. On the upper shelf of the table may be seen the carbon-dioxide absorbers and the spirometer; on the lower shelf are the blower and the water-absorbers. Behind the table are the large oxygen cylinder and gas meter. The tambour and kymograph stand on a small table in the rear.

cylindrical form and was suspended by two ropes connected with a counterpoise, thus providing for raising and lowering the cover. When the cover was lowered, it entered a narrow water seal which made it air tight. A rectangular window in the cover provided for illumination. A general view of the laboratory is shown in Figure 11, in which the respiration chamber is a little to the right of the center, and the table containing purifying vessels for the air at the left.

In studying the change in the energy requirements of the resting, quiet child as growth progresses, we may first consider the energy changes accurately measured on the same individual. We have certain subjects who have been followed almost from birth to four years of age, others who have been followed for shorter periods, beginning some time after birth. The labor involved in following a child for several months, if not years, is much greater than one would realize. It is to be hoped that some time one or more children will be followed from birth to well into adult life. This is something to be striven for. A typical example of the changes in the metabolism of the same individual at different ages in early youth may be seen from the results obtained with a girl baby, G. C. This infant, the child of a normal wet-nurse, was studied from the age of 10 months to 4 years, 3½ months. The heat production under standard conditions was frequently measured. The individual values have been plotted and are given in Figure 12. As no attempt has been made to smooth the curves, the irregularities are strikingly exhibited. Considering first the total heat production as the age increased, we can see that there was a sharp rise in the heat production until about 2¼ years. Subsequently the total heat production remained reasonably uniform, that is, this girl baby at 10 months produced approximately 500 calories, and at 4 years and 3½ months 720 calories, or an increase of approximately 50 per cent.

Since there was simultaneously a pronounced change in the body-weight, the heat values per kilogram of body-weight are of interest when compared with age. Here the effect of age is shown to be very pronounced, for we find that at one year the heat production was 70 calories per kilogram and that at 4 years 3½ months it dropped to 44 calories per kilogram. Thus at 4 years and 3½ months the heat per unit of weight was decidedly lower and the mass of protoplasmic tissue had less heat-producing

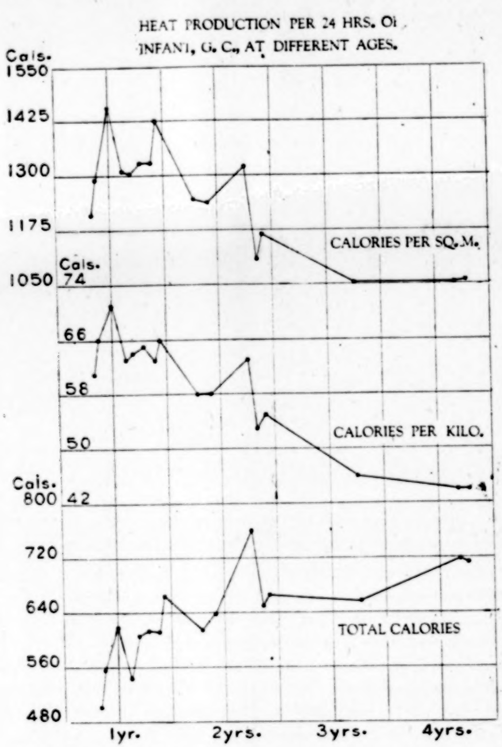

FIG. 12.—Basal heat production per 24 hours of normal infant at different ages.

power than at 1 year when the metabolic changes were very high.

The great irregularities in the heat production per square meter of body surface found with younger children is strikingly shown in the upper curve, in which the range is from 1,456 calories at one year of age to 1,059 calories at 4 years 3½ months. This is a decrease of over 25 per cent. and is strikingly at variance with the popular conception of a "law" which signifies a uniformity in heat production per square meter of skin area.

Since most of our continuous, or semi-continuous, observations on children pertain exclusively to the earlier years of growth, we have no data of comparable nature for later years, and the method of studying a number of individuals and establishing a basal value in each case, subsequently to be used in a scatter diagram or chart, must be followed. In our final summation of results we consider that the child who changed in age six months or in weight one kilogram, or 10 per cent. in weight, can be considered as a new individual and may thus be accorded a special value in our plots, charts, and curves.

While with new-born babies no sexual differentiation was found, it has been demonstrated with adults that women have a measurably lower metabolism than that of men of the same height, age, and weight. Consequently in the discussion of our results, we have separated the boys from the girls. Perhaps the simplest method of considering the metabolism of a group of boys is by comparing the total caloric production to age. For this purpose we have plotted a chart (Figure 13) showing the total basal metabolism of boys of various ages, plot-

ting these values against the ages of the subjects. It is obvious that the number of total calories becomes larger as the age increases. The chart for girls (Figure 14) is similar to that for boys, for as the age increases the total caloric output increases. Since, however, we have found with adults that, although the age factor is of considerable moment, it is of far less importance than weight, we may have here simply an expression of the fact that as children grow older they likewise grow heavier in weight, and the larger organism has a larger heat production. When the basal metabolism is plotted against the weight (Figure 15), we find here also that as the weight of the boys increases the heat increases. Indeed, the curve representing a probable general trend shows the individual points rather more closely grouped about the central line in the curve for the weight comparison than in that for the age comparison. The curve for girls (Figure 16) shows similar phenomena. It is important to bear in mind, however, that these and all subsequent charts deal solely with the basal metabolism, not with the total 24-hour energy requirement, which includes not only the maintenance or "overhead" charge, but likewise the extra costs for the muscular activity which is so pronounced in the case of growing children.

With so rapidly changing an organism as the growing child, it is of interest to determine, if possible, whether or not there is a specific relative change in the rate of metabolism with age and weight. In other words, it is of interest to compare the metabolism of a 5-year old girl with that of a 12-year old girl, just as it is of interest to compare the metabolism of a 100-pound man with that of a 200-pound man. A 5-year old girl weighs not far from 18 kilograms. A 12-year old girl weighs approximately 37 kilograms, or about twice as much. Hence from the standpoint of weight alone it is as desirable to compare the 5-year old girl with the 12-year old girl as it is to compare the 100-pound man with the 200-pound man. Physiologists have long recognized the difficulty of making these comparisons, for even so commonly accepted a method of comparison as the heat production per unit of weight requires the assumption that each weight unit of the body has the same heat-producing power as the others. That is, if we compare the heat production of a 100-pound man with that of a 200-pound man, we are obviously not dealing with like proportions of bone, flesh, and fat in the two men. When we compare a normal, plump, healthy baby with an atrophic baby, these variations are even more striking. With these mental reservations it is still the most common custom of physiologists to express the heat values per kilogram of body-weight. In accordance with this usage we have plotted the values for our children of all ages from 8 days to 15 years, separating the sexes so as to show the heat production per kilogram of body-weight for boys and girls.

The values for boys (Figure 17) show a quite different type of curve from that noted in the comparison of the values for the total heat production, inasmuch as there is a distinct tendency at the age of one year for the heat production per kilogram to be higher than that at the end of 6 months and subsequent to one year. This implies that at the age of one year there is a specifically high basal metabolism which is of itself an extraordinarily important physiological fact. While the number of points on the chart is not so great as one could wish, it still is reasonably clear that the distinct trend of the points after the age of one year is downward, somewhat in accordance with the straight line drawn on the chart. It is doubtless doing violence to mathematics even to infer that after the fifth year a straight line represents the trend of metabolism, and one may fairly challenge the drawing of *any* line or curve to indicate the supposed general tendency in a diagram in which the individual points are as scattered as they are here. Clearly with children we are dealing with physiological entities and not with crystalline structures, each with its mathematically established planes.

There are no markedly irregular groupings in this scatter diagram or line. Some writers have emphasized the supposed profound alteration in the metabolism as the child approaches puberty, particularly about the age of 12 years with boys. Here we find nothing to indicate special abnormality or irregularity. An examination of the curve for girls (Figure 18) shows similar phenomena, *i.e.*, the high values at the age of one year, the distinct tendency for the line to fall from one year to 14 years, with no obvious disturbance in the regularity of the line at or about puberty.

Since we have seen that with growing children age is expressive of great weight changes,

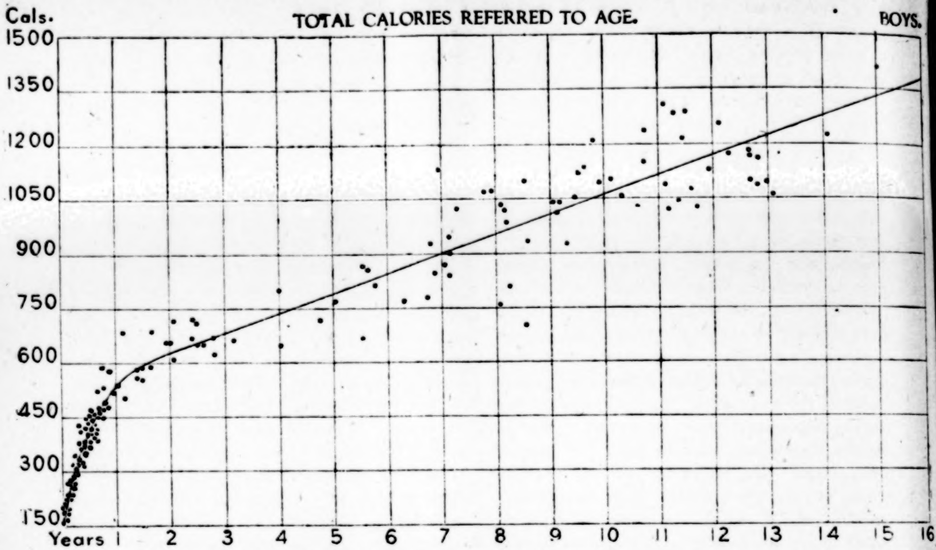

FIG. 13.—Basal heat production of boys per 24 hours referred to age.

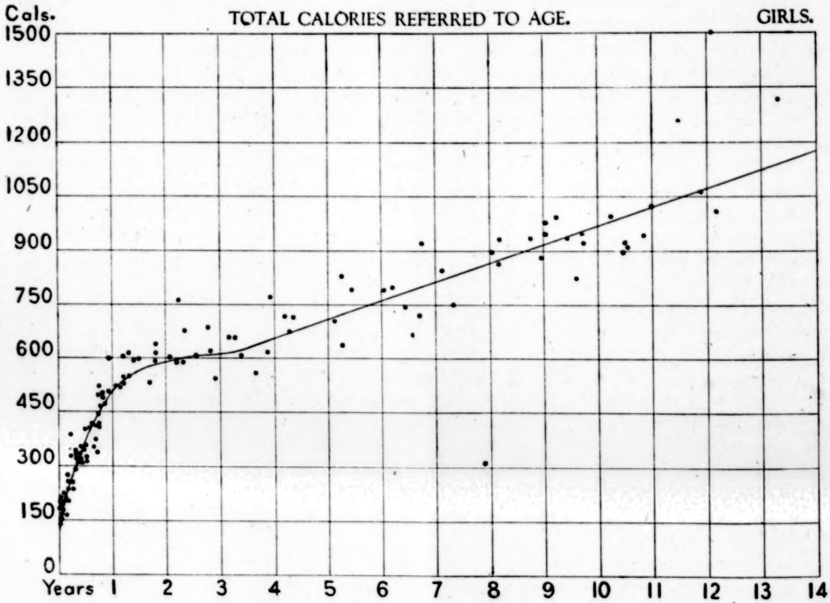

FIG. 14.—Basal heat production of girls per 24 hours referred to age.

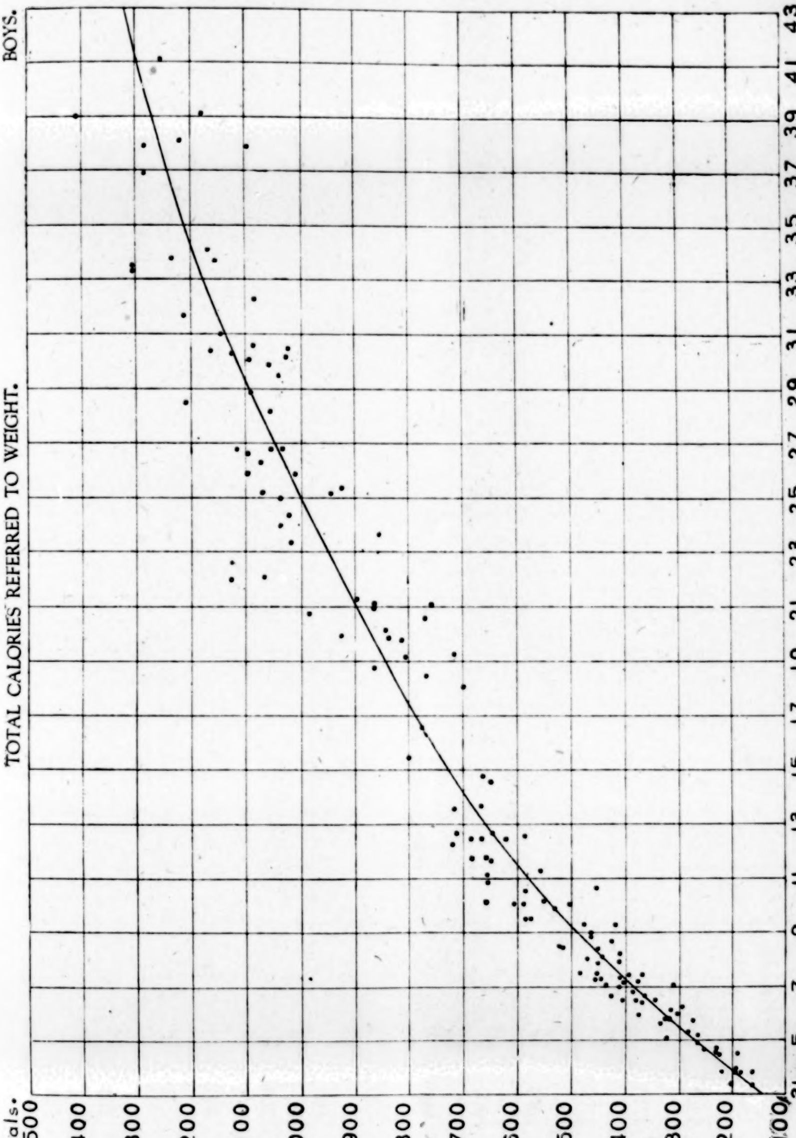

Fig. 15.—Basal heat production of boys per 24 hours referred to body-weight.

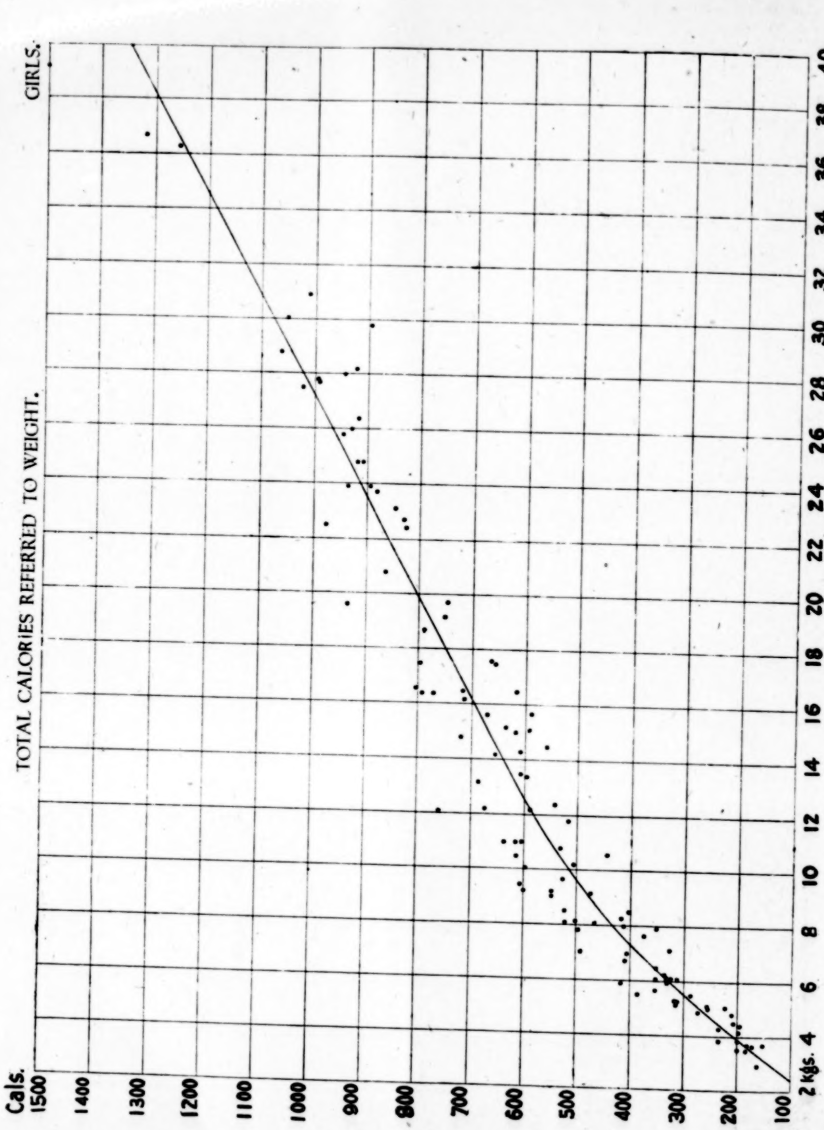

Fig. 16.—Basal heat production of girls per 24 hours referred to body-weight.

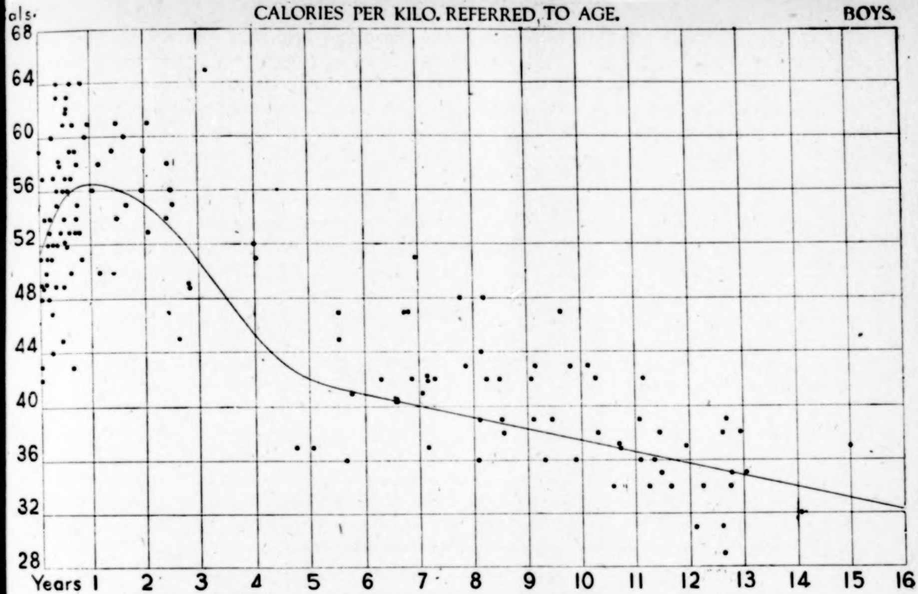

FIG. 17.—Basal heat production of boys per kilogram of body-weight per 24 hours referred to age.

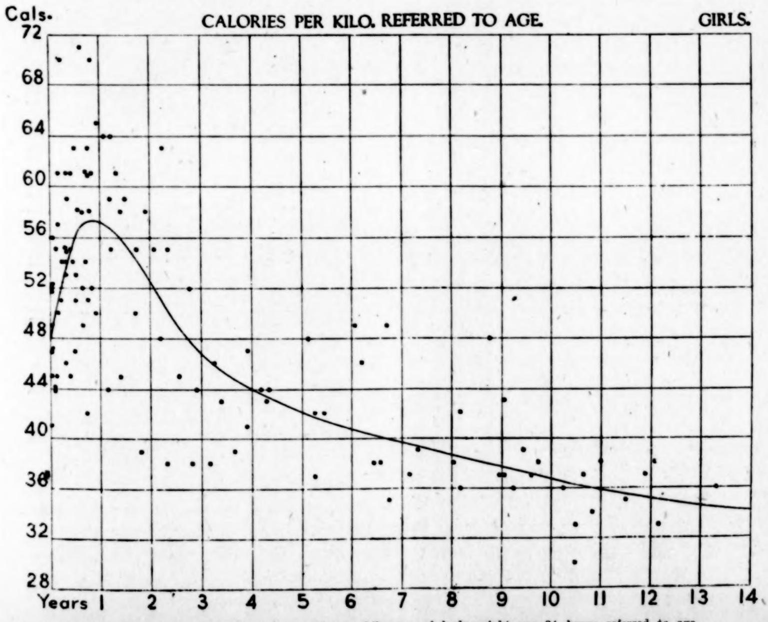

FIG. 18.—Basal heat production of girls per kilogram of body-weight per 24 hours referred to age.

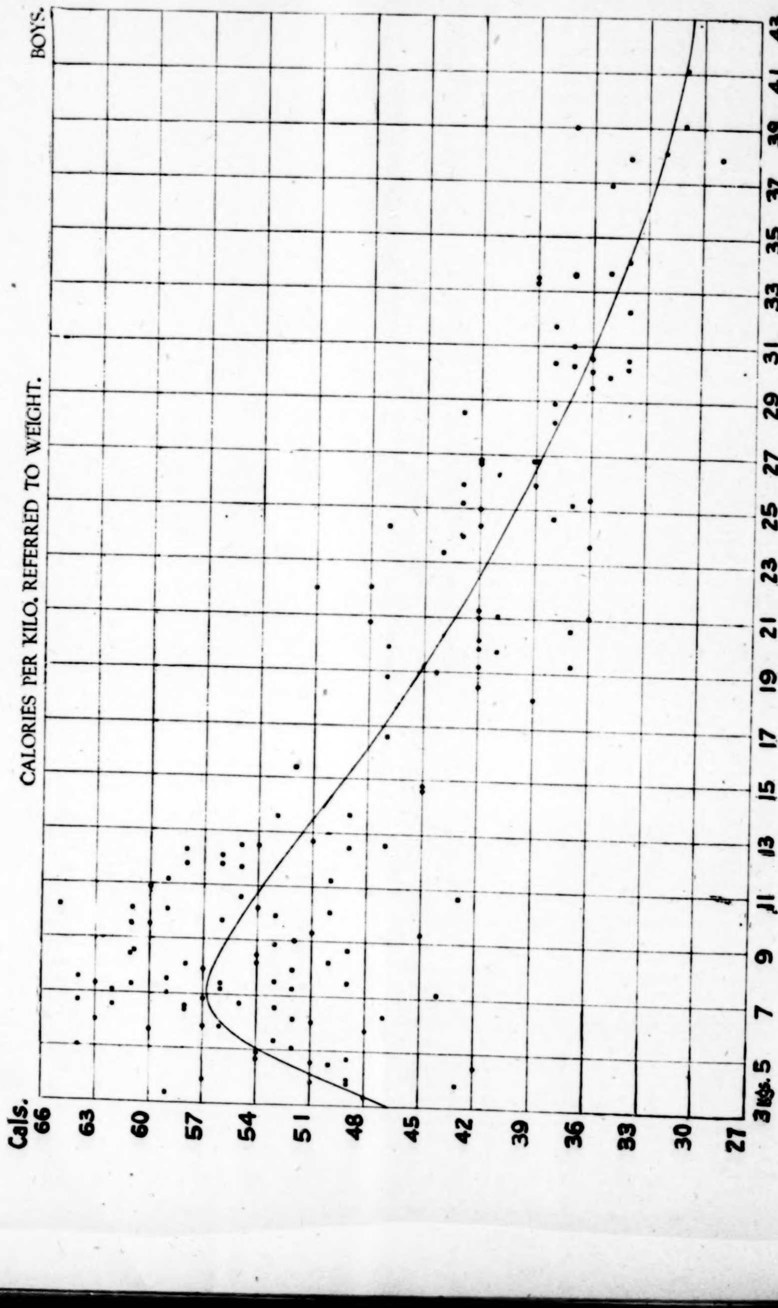

FIG. 19.—Basal heat production of boys per kilogram of body-weight per 24 hours referred to weight.

the differences in age probably in large part simply reflect the concomitant weight changes. A study of the heat production per kilogram of body-weight for the different weights is therefore somewhat more logical than a study of the heat production per kilogram for the different ages. On this basis the boys show a curve (Figure 19) strikingly similar to that for age, the wide distribution of the individual points again showing the futility of assuming any physiological law regarding the basal metabolism in early youth. Our hypothetical line suggests, for example, that the metabolism of a 7-kilogram baby is, on the average, 57 calories per kilogram of body-weight, and yet actual observations show one value of 44 calories and another of 64 calories. The plot for girls (Figure 20) exhibits similar inconsistencies. The general line is wholly problematical and perhaps unjustifiable. At 7 kilograms, for example, the curve indicates an average metabolism per kilogram of body-weight of 56 calories, but two values on the chart for this weight show a heat production of 46 and 70 calories, respectively. With both boys and girls the points are somewhat more compactly grouped for weights about 14 kilograms and higher.

Recognizing the defects in the method of comparing the heat production per kilogram of body-weight, we may further compare these data by a very alluring method which has long been used, namely, by employing the heat production per square meter of body surface. This method of comparison is fundamentally based upon the conception that the heat lost from the surface of the body is greater the larger the surface. While the physiological soundness of this contention has been severely attacked, we may still use the surface area of the body as a factor in the comparison, if we discriminate clearly as to the significance of such comparison. It has been shown that the surface area of the body, the blood volume, the cross section of the aorta and trachea (and probably the total mass of active protoplasmic tissue) develop in accordance with a well-known morphological law of growth, in which the relationship is not directly in proportion to the weight, but more nearly as the two-thirds power of the weight. Since the body surface, as measured by the ingenious method of DuBois, shows close correlation with the two-thirds power of the weight, we may take this as an index of the general differences in the amounts of active tissue of the body and hence it may logically be used for comparison purposes, if the fictitious causal relationship, which has so long dominated the minds of physiologists, is not retained.

With the children used in our observations, we have taken pains to measure the body-surface area carefully, in accordance with the Du Bois formula. Hence we can compare different children on this basis. As previously stated, an ensnaring hypothesis long maintained by physiologists is that the heat production in warm-blooded animals is the same per unit of surface area, practically irrespective of species, *i.e.*, not far from 1,000 calories per square meter per 24 hours. We have computed the basal heat production of our children on the basis of per square meter of body-surface per 24 hours and have plotted them on a chart against age. (See Figures 21 and 22.) If there were any direct relationship between the area and the heat production, we should expect to find uniformity in these values, but quite the opposite is observed. Precisely the same degree of difference at different ages is observed as was noted with the children per kilogram of body-weight. Higher values are found about the age of one to two years with a possible tendency for the values to decrease with greater age, although the distribution of the points is so wide as largely to invalidate any arbitrarily drawn, smoothed curves. It is important now to bear in mind that the differences in size at different ages are practically eliminated in using the body-surface for comparison. This phenomenon is noted with both boys and girls, namely, a distinct lack of constancy, thus refuting the popular notion that the heat production is constant per square meter of body-surface. Furthermore, the age element in children, with special stress on the age of puberty, is shown to play no particular rôle except that about the age of one to two years, high heat values are found on the bases of both body-weight and body-surface. No obvious tendency for a deviation of the line is noted at or about the age of puberty with either boys or girls. In both methods of computation for comparative purposes, *i.e.*, per kilogram of body-weight or per square meter of body-surface, the curves are characterized by exceedingly low values during the first week, a rapid rise at about one or two years, and then a

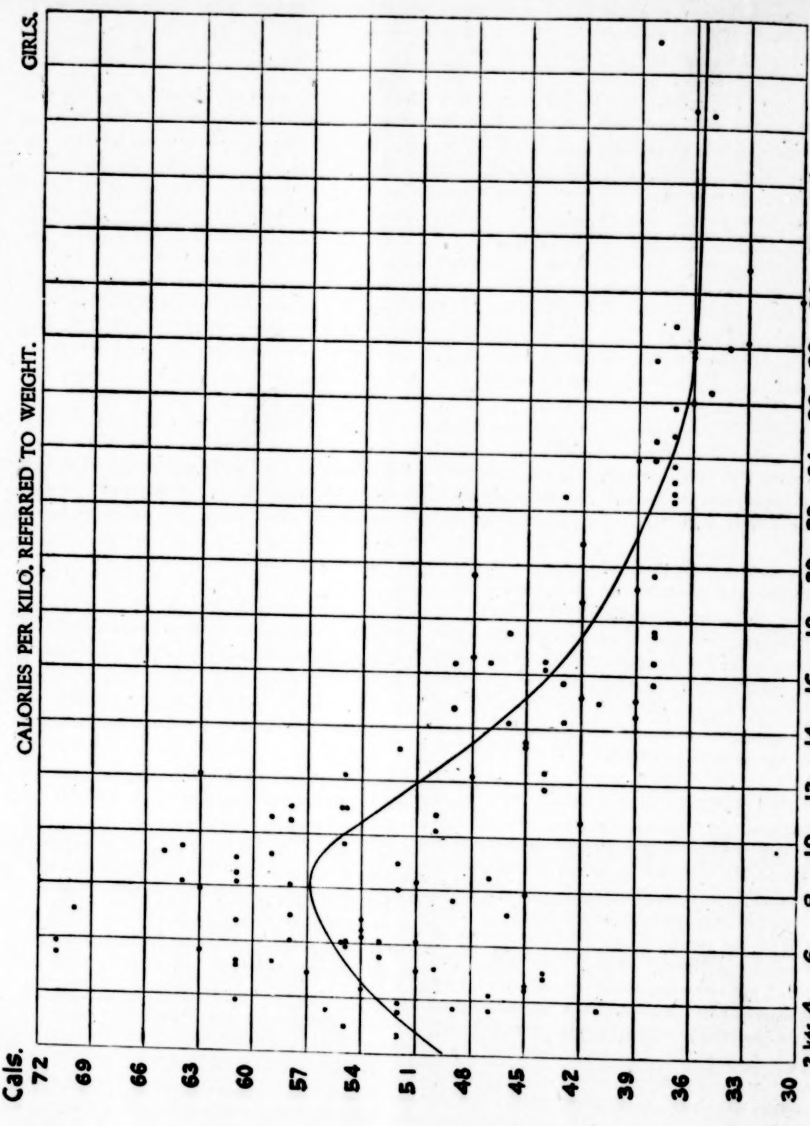

FIG. 20.—Basal heat production of girls per kilogram of body-weight per 24 hours referred to weight.

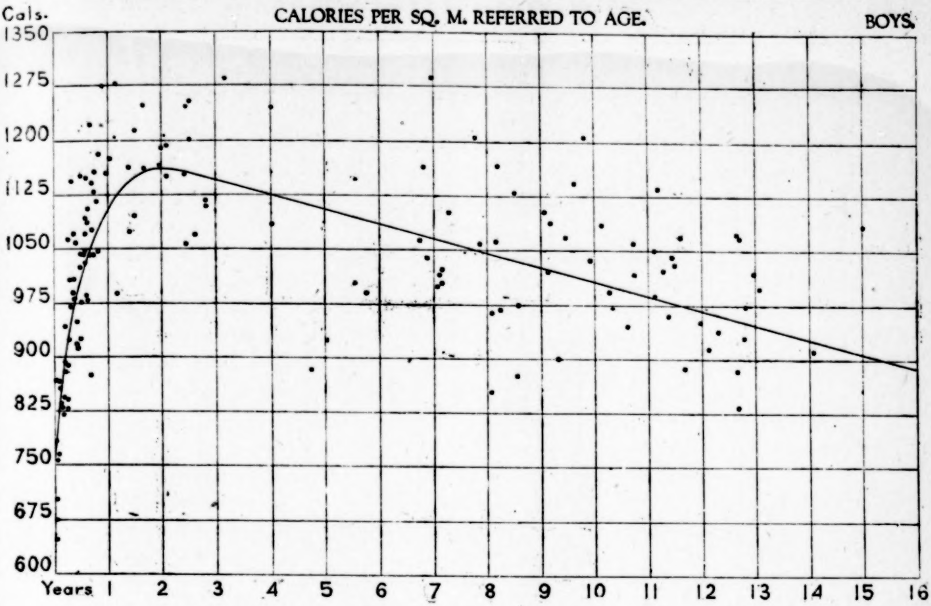

FIG. 21.—Basal heat production of boys per square meter of body-surface per 24 hours referred to age.

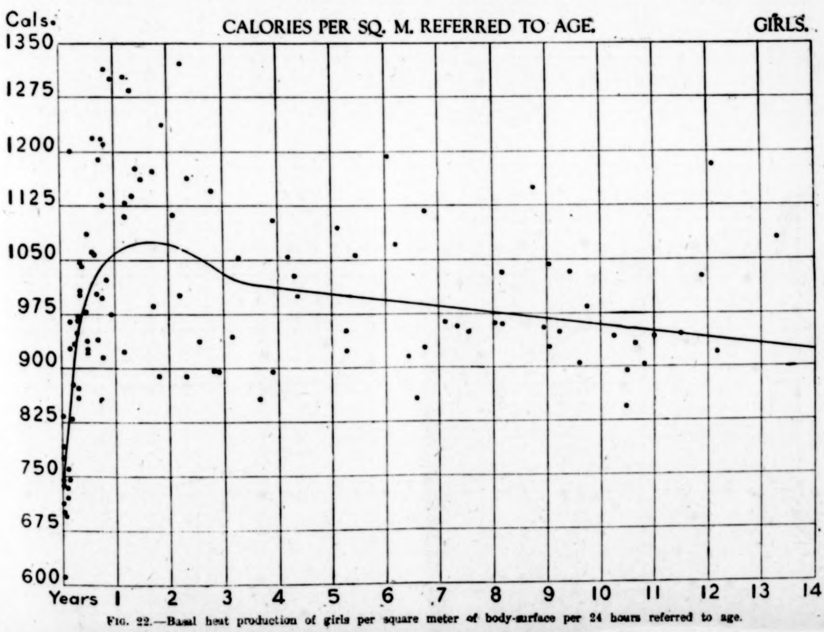

FIG. 22.—Basal heat production of girls per square meter of body-surface per 24 hours referred to age.

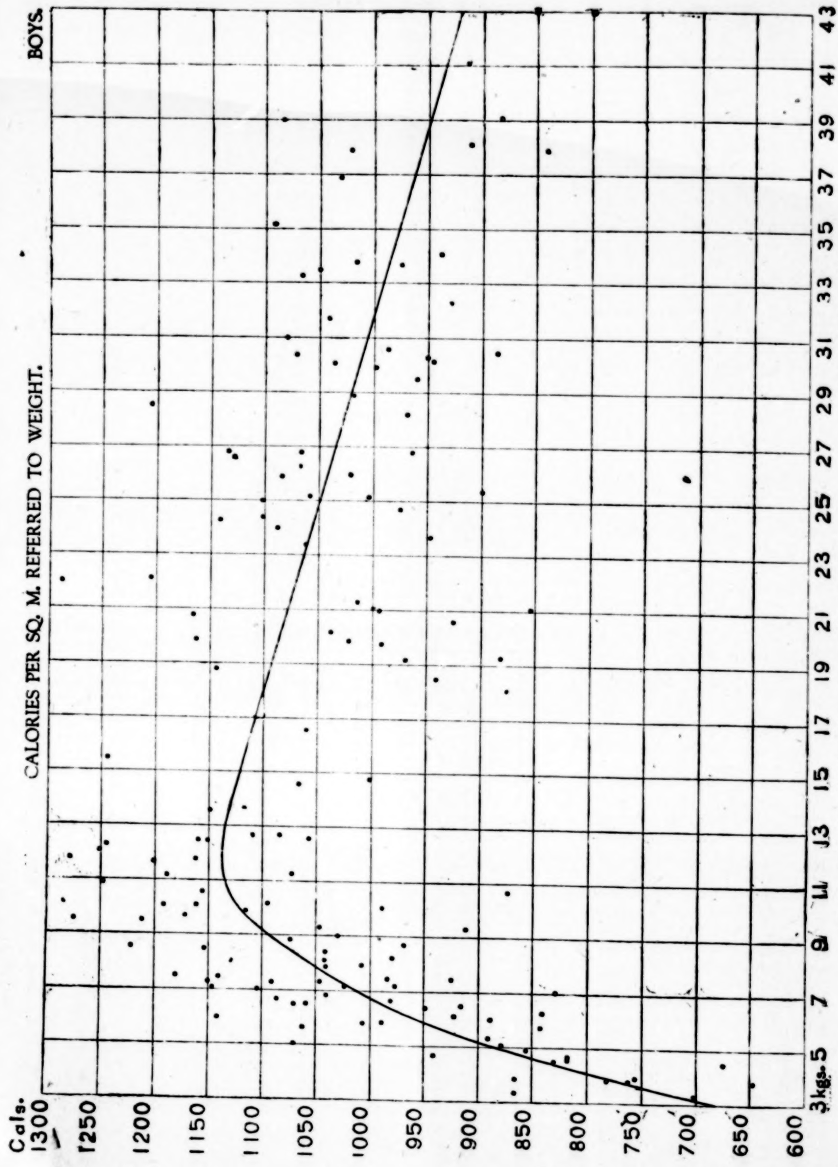

FIG. 23.—Basal heat production of boys per square meter of body-surface per 24 hours referred to body-weight.

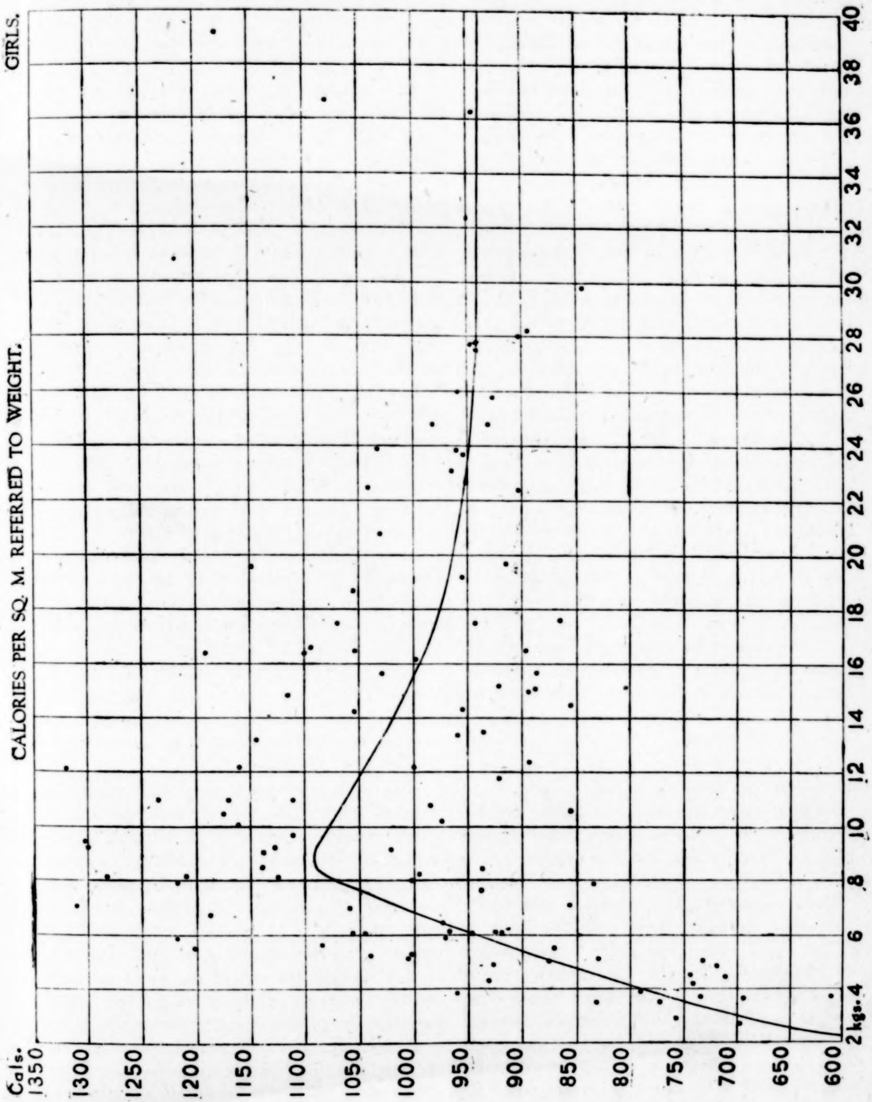

Fig. 24.—Basal heat production of girls per square meter of body-surface per 24 hours referred to body-weight.

steady decline to 14 or 15 years, beyond which our observations do not extend.

While these statements apply to the general course of the hypothetical curves arbitrarily laid down on the several scatter diagrams, the deviations of the individual points are so great as to rule out immediately all claim to a regularity in relationship between heat production and age, either per kilogram of body-weight or per square meter of body-surface, that can fairly be designated as a physiological law.

As previously stated, since the age element may, with growing children, be only indicative of changes in weight, the true relationships may best be expressed by referring the calories either per unit of weight or per unit of area to the true weight rather than to age. The calories per square meter of body-surface, referred to the total weight, are given for boys in Figure 23 and for girls in Figure 24. Any slight semblance of regularity which appears possible from figures 21 and 22, when the calories per square meter were referred to age, practically disappears when these values are referred to weight, although here again the curve suggesting the possible trend in metabolism on this basis is but arbitrary. The deviations either side of the hypothetical line are altogether too great to more than hint at a possible general trend.

So far as average values are concerned, the curves may be taken as indicating general trends, but one cannot say that every 12-year old boy will have a basal metabolism of 970 calories per square meter of body surface or that every 12-kilogram girl will have a basal metabolism of 50 calories per kilogram of body-weight.

In this respect, perhaps, our results are discouraging. It would have been infinitely simpler for the clinician and the physiologist to have dealt with an approximately constant caloric requirement in accordance with weight and age. Still all large problems must be solved not by the investigation of one patient or one subject, but by the investigation of many. That these values differ widely from earlier results cited within a year as "absolutely accurate" is, we believe, not surprising. Few, if any, colleges or medical schools have had men with a breadth of vision equal to Dr. Talbot's, who would continue the study until sufficient data had been accumulated to establish the general trend of metabolism. This research was projected in 1911 and has been constantly and regularly continued ever since. It concludes on July 1 of this year.* That results of 8 years of intensive study differ widely from scattered values drawn from the literature is only to be expected.

The popular impression that children for their size eat much larger amounts of food than adults do and engage in relatively larger amounts of muscular activity leads to the question as to whether there is a specific *basal* metabolism of children measurably different from that of adults. Our studies thus far have enabled us to project a reasonably satisfactory curve for the total metabolism when referred to weight. It will be of considerable importance to compare this with the metabolism of adults, which has been studied quite extensively and recently analyzed in publications from the Nutrition Laboratory.[3] Consequently in Figure 25, beside the curve for the basal calories obtained with boys of increasing weights, we have laid the line found to approximate most closely the relationship between total calories and weight for men. The left hand part of this curve is, therefore, an exact duplicate of Figure 15, while the right is a straight line derived from the analysis of the metabolism of 136 men. This line for men is a singularly interesting continuation of the curve for boys. When the deviations of individual values either side of a straight line for adults are considered, however, too much stress must not be laid upon this, but it is clear that so far as this analysis goes, the metabolism of children follows in a fairly regular line that for adults.

With girls, the comparison with women is made in Figure 26, the left hand portion of which, ranging from 2 to 40 kilograms, is a duplication of Figure 16. The straight line from 36 to 82 kilograms is that representing the general trend of metabolism of adult women based upon the analysis of results obtained with 103 women in the Nutrition Laboratory. The connection between the end of the curve for girls and the beginning of the curve for the lighter women is by no means so regular as was noted with boys. It should be stated, however, that the number of individuals studied at the upper weight limit with girls and the lower weight limit with women is as yet relatively small, and

* A complete report of the results of this investigation will be given in a monograph to be published by the Carnegie Institution of Washington.

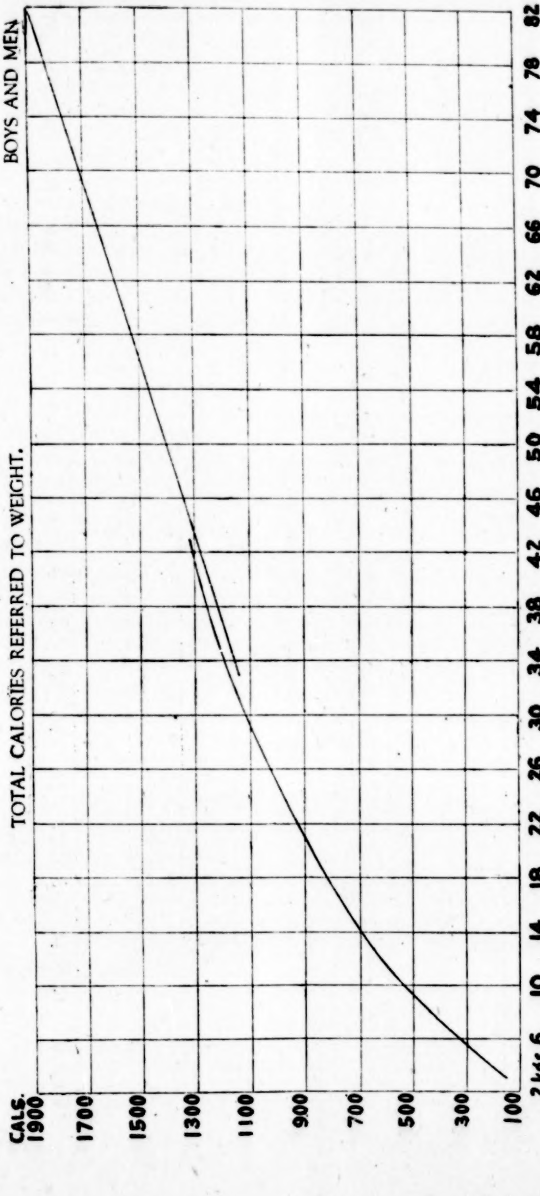

FIG. 25.—Comparison of basal heat production of boys and men per 24 hours referred to body-weight.

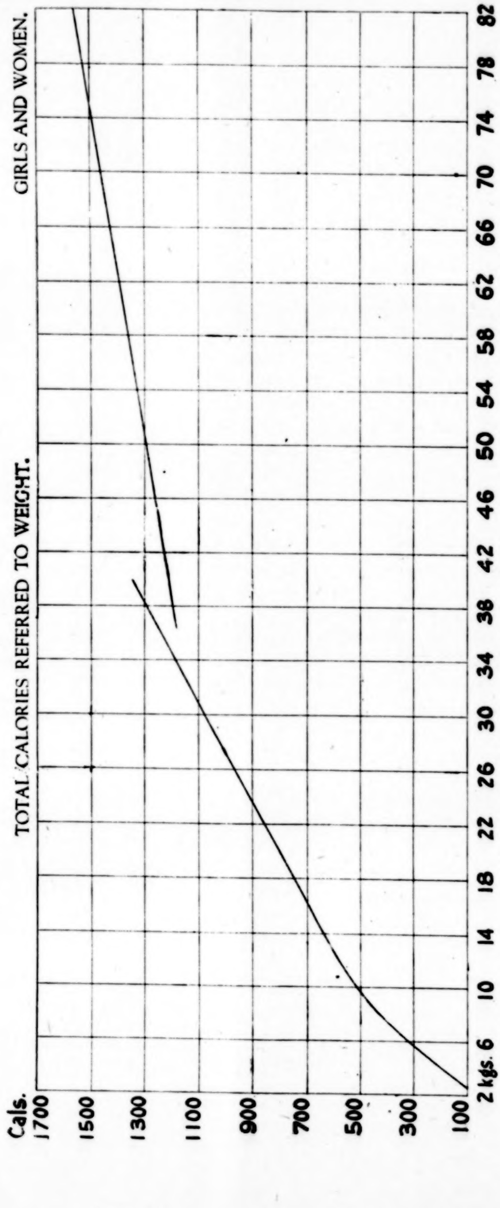

FIG. 26.—Comparison of basal heat production of girls and women per 24 hours referred to body-weight.

that further amplification of these data may show better agreement. If, however, the curves were more or less joined and smoothed to give a general trend of metabolism for females from 2 kilograms to 82 kilograms, it would form a curve similar in general appearance to that noted for males. Both the curves for males and for females show that at the lower weight limits we have an increment in metabolism much greater for each 4 kilograms than appears at the larger weights, thus speaking for a greater and more active metabolism per unit of weight with the earlier ages.

From a general inspection of the two preceding charts, no striking difference is to be observed between boys and girls in the general conformity of the lines, but for a true analysis of sex differences in metabolism the curves should be plotted on the same scale and the same chart. This has been done specifically with the total calories referred to weight in Figure 27. Here the dotted line represents the curve for boys and is an exact duplication of the curve in Figure 15, while the solid line is the curve for girls and is that taken from Figure 16. With both sexes no difference is to be observed until about 8 kilograms, when the curve for boys rises perceptibly above that for girls until it reaches 35 kilograms. At this point the curve for the girls rises above that for the boys. Thus, the metabolism of a boy weighing 22 kilograms will, on the average, be about 70 calories per 24 hours greater than that of a girl of the same weight, while at about 40 kilograms the reverse is true.

The differences in sex as well as differences between youth and adults may best be brought out, however, in comparison curves in which the heat per kilogram of body-weight and the heat per square meter of body-surface are referred to the total weight for both boys and girls and men and women, the latter values being derived from the analysis of the metabolism of men and women previously referred to. In Figure 28 the curves representing the average calories per kilogram of body-weight have been plotted with increasing weights, the broken lines here representing the boys and men and the solid lines the girls and women. The remarkable connection between the first part of the curve representing boys and the latter part representing men, noted in an earlier chart for the total caloric production of the day, is also observed here, and the disagreement between girls and women is likewise here accentuated. The sex differences are not prominent until after about 10 kilograms in weight, when the curve for the boys remains for the most part above that for the girls and that for men is on the average slightly above the curve for women. The line for the girls, which crosses that for boys at 31 kilograms, may possibly be subsequently revised with an extension of observations at or about these weights, for it is clear that between the ages of 12 to 17 years with weights from 30 kilograms to 50 or more kilograms, further ex-

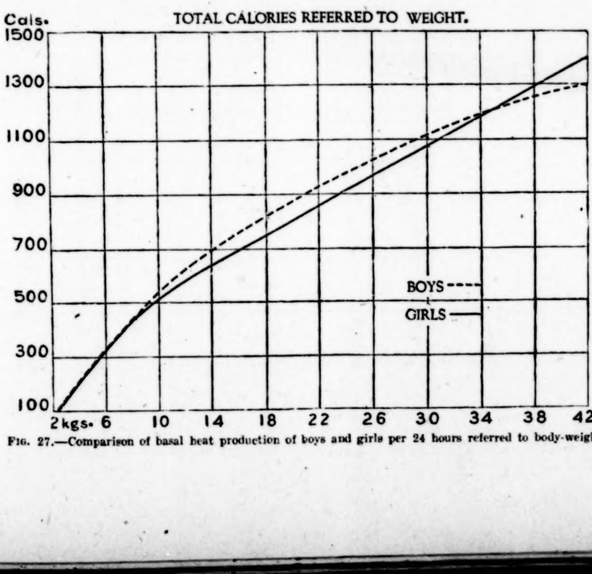

FIG. 27.—Comparison of basal heat production of boys and girls per 24 hours referred to body-weight.

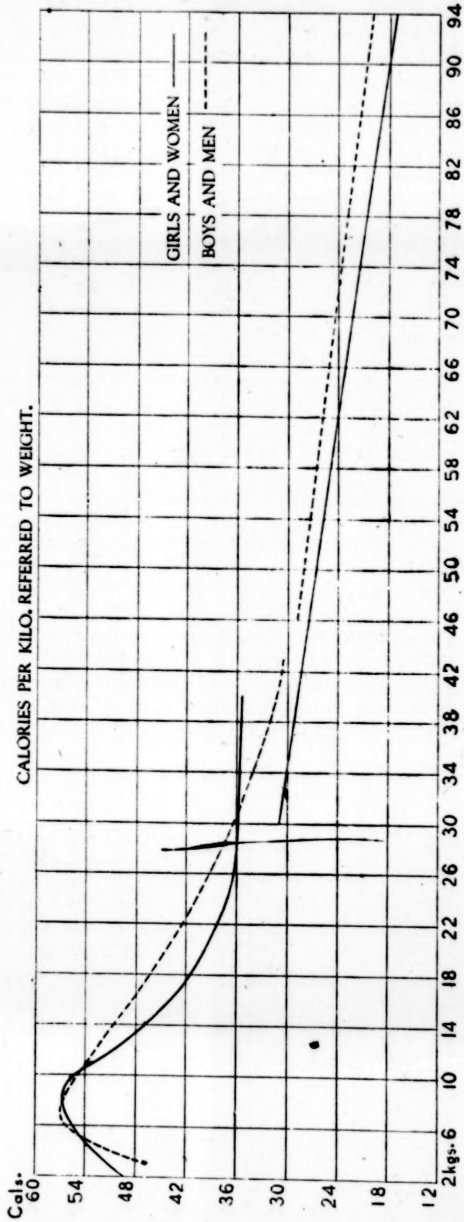

FIG. 28.—Comparison of basal heat production of boys and men and girls and women per kilogram of body-weight per 24 hours referred to weight.

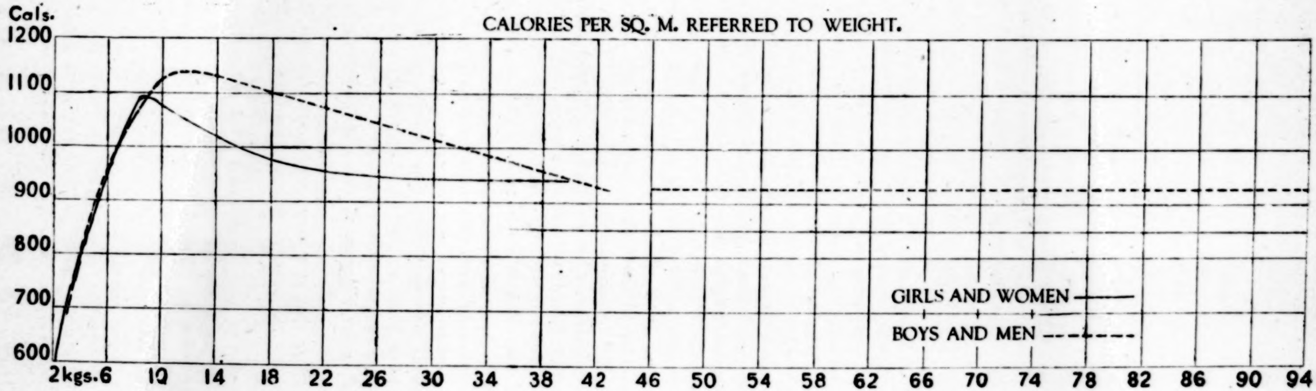

FIG. 29.—Comparison of basal heat production of boys and men and girls and women per square meter of body-surface per 24 hours referred to weight.

perimentation must be done. Such experimentation, however, lies outside of the field here discussed, *i.e.*, the metabolism of children, and is a special problem for study by the Nutrition Laboratory in the immediate future.

Finally, referring to the analysis of the heat production per square meter of body-surface with increasing weights, we note in Figure 29 that up to 8 kilograms no differences in the sexes are to be noted, but thereafter the boys have a somewhat higher heat production on the whole, thus indicating a specifically somewhat higher metabolism with the growing boy than with the growing girl. It is perhaps remarkable, with the differences in growing children shown by common observation of the life habits of girls and boys, that no greater difference between the two is to be seen in the *basal* heat production. The value for men lies perceptibly above that for women. Indeed, for weights above 10 kilograms, one might logically state that the average difference between the two sexes was about 75 calories per square meter per 24 hours. As in the other curves, however, the weight-ranges from 30 to 50 kilograms need further study.

This method of comparison is assumed by most physiologists to be freest from criticism and to give identical values for all sexes and ages, but we note from this chart that these assumptions are far from justifiable. After the child's weight has reached 9 kilograms, the metabolism, both per square meter of body surface and per kilogram of body-weight, has a distinct tendency to fall but is perceptibly higher than that found with adults. The metabolism for girls at 9 kilograms is 30 per cent. higher than that for women, and the metabolism for boys at 11 kilograms is 25 per cent. greater than that for men per square meter of body surface and still higher per kilogram of body-weight.

From these charts it is clear that at a very early age, *i.e.*, with low weights, the metabolism is specifically low. It then rises rapidly until the child's weight has increased to approximately 10 kilograms, when it is at its maximum per unit of weight and per unit of area. There is next a steady decrease until approximately 30 to 40 kilograms, when the early adult period begins. In considering these statements, however, it must be borne in mind that in the making of such curves there is danger of misinterpretation as to the fixity of the lines, and it should be remembered that they represent trends only.

In all of this discussion we have considered only *basal* metabolism. This may seem to thoughtless critics as being a wholly impractical point of view. As a matter of fact, it is of the greatest fundamental interest. The basal metabolism may be, with youth at least, safely compared to that found with the subject asleep, even if the child is not, strictly speaking, in the post-absorptive condition. With the child in bed, resting but awake, the increase in the metabolism will depend entirely upon the activity. We have noted that severe crying increased the metabolism of very young infants 63 per cent. on the average, with a possibility of an increase of over 200 per cent. These factors of course are distinctly problematical. The basal needs are inevitable, and represent a never ceasing 24-hour demand, which is, so to speak, an irreducible minimum. But to supply only the minimum demand for calories in the food would leave the normal child at the end of the day with a large deficit, for the 24-hour demand of the child is made up of minimum or basal demands plus the varying extra demands which are due to several causes. First, food in the alimentary tract of itself stimulates heat production. Energy is further needed to supply the material for growth, this energy being obtained from food. Finally, extra energy is needed for both unproductive and productive muscular activity. If the boy shovels snow, fuel must be supplied to the animal engine for this work. The girl who sweeps or dusts a room needs, as the Nutrition Laboratory has recently shown, approximately 150 per cent. more energy while she is at work than when she is sitting quiet. This factor of the extra energy needs above the basal minimum is one of great variability, most difficult to estimate, and probably much larger than commonly believed. Every one will admit that the growing active boy is a great consumer of food. The popular impression as to the amounts of food so consumed, which seem almost incredible at times, has been fully substantiated by the admirable studies made by Captain Gephart at St. Paul's School in Concord, N. H., in which it was found that the boys averaged 5,000 calories per day.[4] The muscular activity during this period was admittedly excessive.

The intense demand of the active, growing

child for food is evidenced by the constantly increasing habit of supplementing the food obtained at the table by sweets, ice cream, etc. Captain Gephart found approximately 10 per cent. of the total energy obtained by the boys at the St. Paul's School was derived from these sources. So important in the computation of the daily caloric intake have these extra foods become that Mrs. Benedict has been at the Nutrition Laboratory for the past year or two studying directly the caloric content of many of the most commonly consumed extra foods. These have been, in part, reported, and I need but cite the fact that she has found that with an ordinary ice cream soda or "sundae" it is not uncommon to secure 500 calories in one portion.[5] It is not surprising, therefore, that growing children clamor for ice cream cones, doughnuts, and cookies, and are regular patrons of the penny candy counter, the bakeshop, and the soda fountain.

Fortunately the clinician in his estimates of the caloric needs of children has to deal for the most part with the needs of children when moderately quiet and in bed. When a child is very active, it does not, as a rule, need a physician. This is not to be interpreted, however, as disparaging in any sense the careful medical supervision of even so-called "normal" school children. Our analysis of normal versus average and our interpretation of the ideal weights for children lead to the firm conviction that growing children should be supplied liberally with food. It is possible, of course, that when the activity is excessive, there should be some restriction, for there are those who believe that excess activity, even with children, ultimately shortens life. It is still, however, the best practice to give a most liberal diet to children, since the greater part of the evidence on underweight indicates that children usually receive too little rather than too much food. I feel that the question as to whether or not the active growing child can have too much food need not seriously trouble any one. Conservation of food as a war measure, is, happily, a thing of the past. Still, let the obese epicure save all the food he can. Let the over-fed dame of leisure curtail her supply. Both are justifiable on hygienic and, indeed, on real actuarial bases. But further evidence must be forthcoming before nutrition experts will agree on any curtailment of the food intake of active growing children, unless possibly (and God forbid) a new war-need should arise.

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Original Articles.

NUTRITION CLINICS AND CLASSES: THEIR ORGANIZATION AND CONDUCT *

BY WILLIAM R. P. EMERSON, M.D., BOSTON.

ALL children of pre-school and school age may be divided, for the sake of discussion, into three groups: the sick, the well, and the malnourished. The sick are cared for at home and in the hospitals. The well are inspected and receive a certain amount of preventive care from school physicians. The malnourished, about a third of all, receive no treatment for their malnutrition as such, because they are considered well by both private and school physicians. These under-par children make it impossible for the schools to reach reasonable standards of achievement. At the same time the system of school organization compels the teacher to attempt to crowd the pupils through the various grades at high pressure, thus adding to the burden of the under-developed and delicate child. As a result, 20% to 40% of those graduating from elementary schools are physically unfit.

It is remarkable that this group of children has received so little medical attention. They pass through hospital clinics unnoticed because malnutrition among older children is not considered a pathological condition.

WEIGHING AND MEASURING.

The simple procedure of weighing and measuring each child will identify all but the borderline cases. All children habitually 7% or more underweight for their height are not only undernourished but malnourished, retarded in both weight and height from one to four years.

NUTRITION CLINICS.

The object of the nutrition clinic is to identify this group of children and then, on the basis

* Read at the International Child Welfare Conference, called by the Secretary of Labor, Washington, D. C., May, 1919.

of physical, mental, and social examinations, to make a diagnosis of the cause of the malnutrition, thus leading to its proper treatment. It is of as much importance to make this accurate diagnosis in malnutrition as it is in other illnesses. It would be absurd for a physician to ask a group of nurses to care for a ward filled with patients affected with various diseases without informing them of the diagnosis in each case. Yet we are asking school nurses, health workers, and parents to carry out general directions with practically no attempt at diagnosis, resulting in an enormous waste of time, energy, and expense. The nutrition clinic corrects all this by determining the cause of the malnutrition in each instance and then indicating measures for its treatment.

Physical and Mental Examinations. The physical examination reveals an average of more than five defects for each child. When defects interfering with nutrition, especially obstructions to breathing, are corrected, the child is considered free to gain. The mental examination is made in most instances during the course of the physical examination, when it is determined whether there is any question of mental deficiency or retardation. An essential part of the mental examination is to learn the child's disposition and reaction to his environment.

Social Examination. The home life of the child is investigated by a 48-hour record of his program, which includes a list of food taken during that time, his hours of sleep, of work, of play, time in the open air, and, in fact, all his various activities.

Simple causes, as the following, are found adequate to explain malnutrition of the most severe type: fast eating, insufficient food, the use of tea and coffee, late hours, closed windows at night, too little time in the open air, poor hygiene, over-pressure and long hours in school. Such definite diagnoses are essential to successful treatment.

NUTRITION CLASSES.

Having then found the causes of the malnutrition by means of these physical, mental, and social examinations, it requires the co-operation of the child, physician, teacher, and parent to remove them and at the same time to secure for the child the essentials of health. These essentials are the removing of physical and mental causes of poor nutrition, getting the children to take sufficient and proper food at frequent intervals, securing fresh air by day and night, preventing over-fatigue, and establishing sufficient home control to insure good food and health habits. If these results are accomplished, the child should rapidly gain weight and become well and strong, *because of a powerful force in Nature that makes for health.*

Preparation for the Class. Coöperation for the essentials of health is best obtained by means of nutrition classes of not more than twenty children in each. The nutrition worker prepares for the class by the weekly weighing of each child and the recording of this weight on a chart. The charts show the average weight line corresponding to the child's height, and also his actual weight line as he gains or loses. The worker also checks up the diet lists, which are carefully kept by pupil or parent in a small record book for two consecutive days of each week. On these days each article of food taken is recorded, the amounts are indicated in tablespoonfuls or ounces. At this time errors in diet should be corrected and helpful suggestions made, especially in regard to taking milk and cereals. The 24-hour amount should be large enough for gain, usually 2000 or more units (calories). A blue star is given for rest periods and a red star for lunches, if each has been taken every day of the preceding week. In case of failure to gain, personal conferences are held with each pupil in order to discover an adequate cause, which always exists, and therefore should be found by either the nutrition worker or the physician.

Class Conduct. The charts having thus been prepared, the children are assembled by the nutrition worker in a room by themselves, where two rows of seats are arranged, ten seats to each row. The child gaining most is given a gold star and placed at the head of the class. The other children are arranged in order of their gain. The weight chart of each child is hung opposite his place in the class. The nutrition worker keeps a history and record card of each child, which contains the doctor's directions and her follow-up notes. These cards are used by him in considering each child.

When the class is in order the doctor conducts the exercise in such manner as to leave a clear idea in the mind of each child as to what he is to do the following week that he may gain.

The room should be quiet and free from interruptions. Parents should occupy the back seats but the teacher and nutrition worker should be seated in front where they may show by their attention lively interest in each child's progress. The physician praises the children who have gained, but it is his special duty to discover the causes for loss in those who have not gained. These causes are usually failure to take regular lunches or rest periods, fatigue, late hours, etc. This gives an opportunity to show the importance of these factors in the gain or loss of the particular child. A half hour is sufficient time for the physician to take for this exercise. The nutrition worker makes notes and explains the recommendations to each child or parent. Usually the child losing one week is at the head of the class the following week. Where there is complete coöperation and the essentials of health can be wholly obtained, the child should reach his own normal standard of weight in ten or twelve weeks. From 5% to 10% of the children present serious medical problems requiring most careful study by the physician. Even in these cases, however, the class method provides the most satisfactory method of treatment.

Coöperation with the Home. The nutrition worker should visit the child in his home in order to gain the coöperation of his parents and to learn his health habits, especially with reference to eating and sleeping. Plans should be made for open windows at night and plenty of time in the fresh air by day.

Prevention of Over-fatigue. During the period of treatment, the children should be placed in open-air, or at least open-window, classes and school pressure should be reduced. Some children will need only sufficient additional time for rest and lunch periods; many will work to best advantage on a half-day schedule; a few will need to be reduced to two hours a day, while certain cases cannot profitably attend school at all for a time. One rest period of at least half an hour should be taken before the mid-day meal. The child should lie flat on his back, thus correcting his usual fatigue position of stooping shoulders, retracted chest, and prominent abdomen. In the mid-afternoon a similar rest period should be taken but for a longer time.

Food. Mid-forenoon and afternoon lunches should contain about 250 units of such food as will not destroy the appetite for the following meal. Sweets should be avoided at this time. *Children gain faster on less food taken in small amounts five times a day than when a larger amount of food is taken in three meals.*

Authority of the Class Method. The class method appeals to the imagination of the child and makes him do for himself what no one else can do for him. It teaches and inspires him to "train for health" in the same way he trains to be a Boy Scout or a good athlete. Therefore ask him what you will and he will do it cheerfully if he is convinced it is good "dope." The boy of seven or eight years steals off by himself, wraps up in his blanket, and takes his rest periods, or teaches himself to take and to like foods to which previously he had an aversion. He stops drinking tea and coffee, goes to bed early, prepares his bed with hot water jug and papers between blankets, that he may sleep with his windows open on the coldest night. All this he does that he may see his weight line go up each week and the stars registered on his chart.

Successful treatment in the majority of cases is both easy and sure, provided either the physician, nutrition worker, or teacher has sufficient vision to paint true pictures in the child's imagination, thus securing his complete coöperation.

Book Review.

Paper Work of the Medical Department of the United States Army. By RALPH W. WEBSTER, M.D., PH.D. Philadelphia: P. Blakiston's Son & Company. 1918.

The medical officer in carrying out his administrative duties is confronted by many varieties of papers, which, if he is unacquainted with military regulations interfere with the efficient conduct of his daily work. This volume, "Paper Work of the Medical Department of the United States Army," brings together the most important papers which members of the Medical Reserve Corps especially will find of great value in matters of daily routine. Illustrations and explanations are given of papers pertaining to the recruit, to the company or detachment, to medical organizations and hospitals, and to the higher administrative offices. The author has endeavored to incorporate in this volume all the information available on these subjects.

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ENERGY REQUIREMENTS IN HUMAN NUTRITION.

FOR ten years, the Nutrition Laboratory of the Carnegie Institution of Washington has been conducting investigations to determine standard bases of comparison in human nutrition. A recent issue of *Science* contains an article by Dr. J. Arthur Harris and Dr. Francis G. Benedict, describing the research work of this institution on this subject. This is a problem of great practical importance, inasmuch as industrial efficiency and physical well being are dependent upon a knowledge of the amount and kind of food required by the individual.

In a problem of this sort, it is necessary to consider the characteristics of human individuals. Muscular work requires more food supplying energy than less active occupations, and it is probable that an older person requires less food than a younger one. In order to make investigations on this subject of practical value, they must be expressed in a quantitative form, in calories per unit of time.

The measurement of the amount of oxygen consumed and the quantity of carbon dioxide excreted from the lungs furnishes an index of heat production, or the setting free of energy in the human body. There are two methods by which this may be computed—either by means of a calorimeter or by measuring gaseous exchange in a respiration chamber. Lavoisier, Rubner, Zuntz, Atwater, Rosa, Lusk, and DuBois have made experiments in the development of apparatus for the measurement of both heat production and gaseous exchange.

Besides physical and chemical elements, biological factors must also be considered. It is now possible to measure the energy transformation required in muscular activity. It has been generally agreed by physiologists that heat production at complete muscular repose and in the post-absorptive state be called the basal metabolism and made a standard of comparison in investigating problems of human nutrition. Investigations have been made by the Nutrition Laboratory on one hundred and thirty-six men, one hundred and three women, and ninety-four new born infants. These experiments have shown that basal metabolism is variable and not wholly independent of bodily dimensions; yet, although the metabolism of men of any stature is highly variable, there is a tendency for taller men to show greater daily heat production. Experiments tend to show that the coefficients measuring the relationship between body weight and metabolism are in all cases higher than those between stature and metabolism, and that the body mass is a more important factor in determining the basal daily heat production of the individual than is a linear bodily dimension such as stature. The question then arises, whether the greater heat production of tall individuals may not be merely the resultant of the relationship between stature and weight on the one hand and weight and metabolism on the other. In this connection, the results given in this article show that both stature and body weight have independent significance in indicating daily heat production. This fact is of great importance, as it underlies the determination of the best formulae for the prediction of the basal metabolism of the individual.

The results of investigation of the relationship between metabolism and age are of importance

not only to the clinician, but also to the biologist in their bearing upon the general problem of senescence. It has been shown by linear equations that basal metabolism decreases with age during the period of adult life. In men, the daily heat production decreases about 7.15 calories, and in women, 2.29 calories per year.

The practical significance of the formulae presented in this article may be tested by applying them to the clinical investigation of the influence of some disease, diabetes, for example, on the metabolism; for by comparing the caloric output of the subject in a pathological state with normal metabolism, conclusions can be drawn in regard to the influence of the disease.

The study of basal metabolism of large numbers of individuals in good health and living under normal conditions furnishes a valuable standard of comparison in the investigation of the special problems of energy requirements in human nutrition. The work of these investigators in determining proper biometric constants and equations should be appreciated, inasmuch as they have contributed knowledge which will be of great value in maintaining the industrial efficiency and physical energy of the nation.

THE ROCKEFELLER FOUNDATION.

A review of the work of the Rockefeller Foundation for the year 1918 has been published recently by George E. Vincent, president of the Foundation. Through its own departments and by coöperation with seventeen independent agencies, the Foundation has conducted campaigns against disease and has assisted the advance of medical education.

The Foundation's Commission for the Prevention of Tuberculosis in France, under the leadership of Dr. Livingston Farrand, found upon arriving in the land of Louis Pasteur that there was already in existence almost every effective agency known to modern medicine and public health administration in combating consumption. The theory and the principles which underlie the control of tuberculosis, the organization and administration of dispensaries and sanatoria, and the organization of local communities, relief measures, and educational work was thoroughly understood by French scientific men.

There appeared to be, however, one contribution which the American Commission could contribute to the control of tuberculosis in France. The various institutions already existing were isolated and unrelated, and there was no efficient, coöperative, centralized organization for a united, comprehensive attack on tuberculosis. It was in the introduction of organized team play that the American Commission proved to be most valuable. The Nineteenth Arrondissement in Paris and the Department of Eure-et-Loir of the provinces were selected for the demonstration of American methods.

A group of American nurses who could speak French fluently were secured, and centers were organized in Paris where French nurses could take special courses. The medicinal "Tank," an invention of the Rockefeller Foundation, entered French villages and cities and introduced public health education by means of lectures, posters, advertising, and demonstrations. Efforts were made to extend health work in 27 departments by organizing local communities to establish dispensaries; by the end of the year, 57 new dispensaries had been opened, two others were being installed, and plans for 49 more had been definitely laid. Arrangements were made also for 15 laboratories. Almost the entire expense, both for the creation and for the maintenance of these activities, were borne by the French people. At the present time, an effort is being made to establish a complete system of dispensaries of the Région du Nord. It is expected that when the Commission withdraws from France, this work will continue and a nation-wide system for combating tuberculosis, will become a permanent part of the policy of France.

The work of the Rockefeller Foundation in the control of malaria has been continued during 1918. As an example of its effectiveness, it may be mentioned that in Hamburg, Arkansas, the number of malaria cases has dropped from 2,312 in 1916 to 58 in 1918.

The investigation of yellow fever has been under the direction of General William C. Gorgas, who made a preliminary journey to Central America before the end of 1918. When a yellow fever epidemic was reported in Guatemala in June, 1918, by permission of the Guatemalan Minister in Washington, Dr.

Joseph H. White was sent to Guatemala and received the necessary authority and aid for carrying on his work. The epidemic was brought under control, and on December 4, it was reported that no yellow fever remained in Guatemala. A commission of five men sent to Guayaquil, Ecuador, to stay for two months, secured important information concerning the bacteriological, chemical, and clinical aspects of yellow fever.

The progress made by the Foundation in the control and prevention of hookworm infection has been considerable. Infectious surveys have been made to determine the prevalence of the disease, intensive demonstrations of treatment have been made, educational campaigns have been conducted, and persistent efforts have been made to secure the provision of proper sanitary facilities and regulations. During 1918, work for the relief and control of hookworm disease was carried on in coöperation with twelve states in the United States and with twenty-one foreign states and countries.

In the interest of preventive medicine, the Rockefeller Foundation established the School of Hygiene and Public Health in October, 1918, under the auspices of the Johns Hopkins University in Baltimore. This school will provide thorough courses in the fundamental chemical, biological, and medical subjects in specialized phases, and will, in addition, emphasize the importance of vital statistics, sanitary engineering, the sociological aspects of public health, community surveys, and the technique of administration.

The plans of the Foundation for future development of public health control and medical education in foreign countries are extensive. Physicians and medical students will come from Brazil, China, and France to study, with the aid of Foundation fellowships, in leading medical schools in the United States. Work on the construction of the fifteen buildings of the Peking Union Medical College has been continued during the year, although there have been inevitable delays due to difficulty in securing materials from the United States. The pre-medical school, which opened in 1917 with eight pupils, increased its enrollment in 1918 to 17. Plans have been made for another building at Shanghai. During 1918, the China Medical Board gave aid to one or two medical schools and to 19 hospitals which are conducted in China under the auspices of several missionary boards. Medical education in South America has been advanced by the organization of a new Department of Hygiene in connection with the *Faculdade de Medicine e Cirurgia* at Sao Paulo. In 1918, a total sum of $55,000 was expended for fellowships and scholarships to students from foreign countries or to American missionaries at home on furlough.

Among other fields of usefulness the Foundation has assisted the Rockefeller Institute for Medical Research; it has made possible, by appropriations, studies in mental hygiene, infantile paralysis, public health nursing, and industrial relations. The total expenditures of the Foundation for war purposes,—for camp and community welfare, medical research and relief, and humanitarian aid,—amounted to $22,444,815. These activities of the Rockefeller Foundation are consistent with its program, which has for its dominant purpose the promotion of the welfare of mankind throughout the world.

MEDICAL NOTES.

THE LISTER INSTITUTE.—The activities of the Lister Institute during the past year have been outlined in a recent issue of *Science*. This Institute, unlike other medical organizations in London, is an independent organization endowed by private benefactors. The staff of the Institute has devoted considerable time during the year to bacteriological examinations for the London County Council and other public bodies, and to the production of serums and vaccines for the War Office and the Government of Egypt. Research investigations have been made on the virus of trench fever and typhus fever, and the transmission of these diseases by lice, on anaerobic bacteria of wounds and the preparation of standard samples of the toxin of *Vibrion septique*, on the properties of accessory food factors and the effects of the deprivation of them on the various animals, and, at the request of military authorities, research has been conducted to determine the cause of scurvy.

HONOR FOR DR. W. J. HOLLAND.—Dr. W. J. Holland, director of Carnegie Institute, Pittsburgh, has been honored by having conferred

upon him the title of Commander of the Order of the Crown of Belgium in recognition of his services to that country.

NOMINATION OF DR. ALEXANDER C. ABBOTT.—Dr. Alexander C. Abbott, who has been serving with the United States Medical Corps, has been nominated for a position on the Philadelphia Board of Health.

CANCER MORTALITY RATES.—A recent issue of *Campaign Notes,* issued by the American Society for the Control of Cancer, comments upon the cancer death rate in Great Britain and the United States. It has been observed that in England and Wales the cancer death rate has shown a decided increase during the war; but it is believed that this may be accounted for by the fact that so large a proportion of the male population has been removed to France and Belgium, leaving only the older age groups, in which cancer is naturally much more frequent, at home. During the war the rate for cancer mortality has greatly increased among males, but there has been little change among females. For the three years preceding the war, the cancer death rate among men was 91 per 100,000 of population; in 1916, 96 per 100,000; in 1917, 98 per 100,000. The rate for the same period before the war among 100,000 women was 99; in 1916, 101; in 1917, 100.

In considering the relative prevalence of cancer in any particular locality, it is necessary to take into account the age distribution of the population. In this country, Vermont has the highest cancer death rate, the figures reaching 108.9 in 1914, while the rate in Utah was only 45.6. It is probable that this may be explained by the fact that the present inhabitants in Vermont are chiefly within the older age groups, while the young people have largely emigrated to the industrial centers of other states.

AN ACTIVE CENTENARIAN.—Mrs. George DeBeck, the oldest resident of British Columbia, celebrated her 105th birthday on June 27 at her home in Marpole. She was born in St. Johns, N. B., in 1814, and went to the Pacific Coast about 50 years ago. Mrs. DeBeck has over 100 direct descendants, including her children, grandchildren, and her great-grandchildren. Of her own twelve children, only five are now living. Despite her extreme age, Mrs. DeBeck is still active and retains all her faculties to a remarkable degree. During the war, she assisted in war work, knitting many pairs of socks for the soldiers.

OUT-PATIENT CLINICS FOR MENTAL DISEASE AND DEFECT.—There has been published recently a list of 39 neuro-psychiatric out-patient clinics in Massachusetts for the examination and treatment of mental disease and defect. This list has been prepared by the Massachusetts Society for Mental Hygiene for the information and convenience of physicians, judges, school authorities, Red Cross workers, district nurses, social service workers, and others, as well as for the growing number of voluntary patients seeking the aid of qualified experts. This list may be of interest to discharged soldiers who are suffering from war neuroses and who may desire to select the clinic nearest their homes for advice and treatment.

MEETING OF NEW YORK PHYSICIANS.—At a meeting of prominent physicians and surgeons in New York recently, the New York Association for the Advancement of Medical Education and Medical Science was organized. It is reported that Dr. Royal S. Copeland announced plans for the erection of a $50,000,000 medical college in New York, in order to provide better facilities for medical instruction, both graduate and under-graduate. The object of the association will be to establish a working affiliation of the medical schools, hospitals, laboratories, and public health facilities of the city and to create a "medical educational foundation" to finance medical education and investigation.

Dr. Wendell C. Phillips was elected president of the association; Dr. George D. Stewart, vice-president; Dr. Haven Emerson, secretary. A board of fifteen trustees will manage the institution, with the mayor, commissioners of charities and health, and the president of Bellevue and allied hospitals *ex-officio* members of the board.

GERMS AND DISEASE.—Dr. H. A. Zettel of St. Paul and Dr. H. W. Hill, executive officer of the Minnesota public health association, have agreed to expose themselves to contagious dis-

ease germs, including typhoid, smallpox, and bubonic plague, in support of their contradictory theories. Dr. Zettel, believing that germs do not cause disease, will use in his defence against the germs only sanitation, pure air, and sanitary food and drink. Dr. Hill will expose himself after scientific inoculation and vaccination. The two doctors are to expose themselves simultaneously to the same diseases and will then enter quarantine to await the result.

Dr. Hill was bacteriologist in Boston from 1898 to 1905 and was for a number of years director of the bacteriological laboratory of the Boston board of health. He resigned in 1905 to assume the position of assistant director of the Minnesota state board of health laboratory and assistant professor of bacteriology of the University of Minnesota.

Conference on Reconstruction in London.—A conference was held in London from June 25 to June 28 for the purpose of considering problems of reconstruction. The subjects were considered under the following heads: The Work of the Ministry of Health; The Prevention and Arrest of Venereal Disease; Housing in Relation to National Health; Maternity and Child Welfare; and The Tuberculosis Problem under After-War Conditions.

Peking Union Medical College.—The Peking Union Medical College, Peking, China, will be open for the instruction of students in October, 1919. The school has been built under the direction of the Rockefeller Foundation, and will be open to both women and men. A premedical school offering a three years' course was opened in 1917.

Promotion of Frederick L. Bogan.—Major Frederick L. Bogan, M.R.C., has been promoted to the rank of lieutenant-colonel in the Medical Reserve Corps of the United States Army. During the war, Major Bogan has rendered distinguished service as commander of the 102d Field Hospital of the 26th Division. While in service in the Toul sector, he devised a medical instrument for the registration of blood pressure which proved of great value in the treatment of sick and wounded soldiers, and was later placed in the Army Medical museum at Washington.

Medical Social Work for Nurses.—A special course has been arranged by the Public Health Service, in coöperation with Columbia University, Bellevue Hospital, and the New York School of Social Work, for instructing graduate nurses in medical social work. The American Red Cross has provided fifteen scholarships for this work. The course opened on July 1, and will continue for about four months: its purpose is to offer to qualified women a view of the social problems implied in the control of venereal diseases. Speakers for the course have been chosen for their special study of individual aspects of the problem. Students will attend certain lectures at the regular course at Teachers College, as well as the special lectures on the study of the causes, social and economic, of venereal diseases, including racial tendencies, conditions in home and family life, defective education, the nature of recreation and diversions offered for the leisure of young people, personal and community standards, conditions of country and city, and the problems of adolescence, low mentality, drug taking, and alcohol.

The course will also consider the problems of control and prevention of venereal diseases by administrative and educational means. The closing weeks of the course will be spent in the study of social service in the clinics of Bellevue Hospital.

Further information concerning this course may be had from Assistant Surgeon General C. C. Pierce, Division of Venereal Diseases, United States Public Health Service, 228 First Street, N. W., Washington, D. C.

British Birthday Honours List.—*The British Medical Journal* has published recently from the Birthday Honours List some interesting announcements of the recognition of the services rendered during the war by temporary and territorial medical officers.

The K.C.B. is conferred on Sir Anthony Bowlby, who has been consulting surgeon at General Headquarters in France since 1914. The K.C.M.G. is conferred also on Major-General Sir Wilmot Herringham, who served as consulting physician at various times of the First, Third, and Fourth Armies, and was at Head Quarters during the greater part of the war; on Major-General Cuthbert Wallace, who was consulting surgeon with the First Army throughout; on Colonel W. T. Lister, who was

ophthalmic specialist with the armies in France; and on Major-General Richard H. Luce, C.B., of Derby, a territorial medical officer of long standing, who was D.D.M.S. of the Eastern Force. Among officers of the Australian Army Medical Corps honored are Sir Neville R. House, V.C., K.C.B., Director of Medical Services, and Colonel Henry C. Maudsley, of Melbourne, who served in Europe throughout the war; both receive the K.C.M.G. Surgeon-General Charles S. Ryan, C.B., Consulting Surgeon to the Australian Force, receives the K.B.E. The same distinction is conferred upon a number of consulting officers of the Territorial Force who served chiefly in this country; among them are Colonel Henry Davy, C.B., of Exeter, who has been consulting physician in the Southern Command; Lieut.-Colonel D'Arcy Power; Colonel Hamilton A. Ballance, C.B., of Norwich; Colonel Charters J. Symonds, C.B., Sir Arthur W. Mayo-Robson, who have been consulting surgeons of the Southern Command; on Sir Robert Jones, C.B., Inspector-General of Military Orthopaedics; on Lieut.-Colonel Sir Shirley F. Murphy, who placed his immense knowledge of London sanitary administration at the disposal of the London Command; on Colonel G. Sims Woodhead, Professor of Pathology in the University of Cambridge; on Lieut.- Colonel Douglas Reid, C.M.G., of St. Thomas's Hospital, who has been President of the War Office X-Ray Committee; and on Lieut.-Colonel F. W. Mott, F.R.S., whose work at the Maudsley Military Neurological Hospital has been of great value.

The medical staff of the British Forces in Italy is honoured in the person of Major-General F. R. Newland, C.B., who was D.M.S., and receives the K.C.M.G., and Colonel C. Gordon Watson, C.M.G., who receives the K.B.E. The same distinction, conferred on Colonel H. M. W. Gray, C.B., of Aberdeen, will give great pleasure to those who served with him in the Third Army in France and afterwards when he came home to work with Sir Robert Jones in the department of military orthopaedics. Among the regular officers honoured are Lieut.-General Sir William Babtie, K.C.M.G., who receives the K. C.B.; Major-General Harry N. Thompson, who was D.M.S. of the First Army and is now D.M. S. of the army on the Rhine, who receives the K.C.M.G.; and Major-General G. B. Stanistreet, C.B., Deputy Director-General at the War Office, and Colonel R. H. Firth, C.B., an authority on general as well as military hygiene, who received the K.B.E. The distinction of C.B. is conferred on Colonel William Taylor of Dublin, one of the consulting surgeons to the forces.

Of the civil honours conferred we may note the knighthoods to Dr. John Baker, Superintendent of the Broadmoor Lunatic Asylum, and to Dr. Douglas Shields, a Melbourne graduate who has been senior surgeon to the Officers' Hospital, Park Lane, London, during the war, and the C.B. to Dr. R. W. Branthwaite, one of the Commissioners of the Board of Control.

RESOLUTION OF THE AMERICAN MEDICAL ASSOCIATION.—In order that the health of communities may be safeguarded, the prompt reporting by physicians of cases of communicable diseases is necessary. In order to support this law and public health work, at a recent meeting at Atlantic City, the Section on Preventive Medicine of the American Medical Association passed the following resolution:

Resolved, That the Section on Preventive Medicine and Public Health of the American Medical Association recommend to the House of Delegates that it ask the constituent associations to consider the advisability of such amendments to their by-laws and to those of this association as will eliminate from membership any physician who wilfully fails or refuses to comply with local or State laws for the prevention of disease, including especially the provisions in such laws requiring the reporting of cases of communicable disease.

This resolution indicates the purpose of the American Medical Association to insist that members of the Association perform faithfully the duties of a physician, not only to his patients but also to the public at large.

BIRTH STATISTICS AND INFANT MORTALITY.—A recent Public Health Report states that in the birth-registration area of the United States 1,353,792 infants were born alive in 1917, representing a birth rate of 24.6 per 1,000 of population. The total number of deaths in the same area was 776,222, or 14.1 per 1,000. The births exceeded the deaths by 74.4 per cent. For every State in the registration area, for practically all the cities, and for nearly all the counties, the births exceeded the deaths, in most

cases by considerable proportions. The mortality rate for infants under 1 year of age averaged 93.8 per 1,000 living births.

The birth rate for the entire birth-registration area fell below that for 1916 by two-tenths of 1 per 1,000 population; but the death rate was less by six-tenths of 1 per 1,000 than in 1916.

Gift to Washington University School of Medicine.—A grant of five thousand dollars has been received by the Washington University School of Medicine for the purpose of investigating hypertrichiasis. The work will be conducted chiefly in the fields of anthropology and heredity.

University of Nebraska.—The will of the late Clementine C. Conkling has provided that real estate in the city of Omaha, to the approximate value of twenty-five thousand dollars, be bequeathed to the College of Medicine, University of Nebraska, Omaha.

Chair of Bacteriology.—We learn from a recent issue of *Science* that the sum of £15,000 has been offered to the London Hospital by the Goldsmith's Company for the endowment of a chair of bacteriology, to be known as the Goldsmith's Company chair of bacteriology.

Medical Conference at Milan.—At a conference held recently at Milan, Professor F. Mariani considered various problems relating to conditions of the heart. He discussed the resistance of the cardiac muscle, the importance which one should attach to the defects of the orifices, and to the functional conditions of the muscular fibre of the heart. He illustrated by x-ray pictures the heart and the aorta, and discussed the importance of new studies on the primitive bundle for the pathogenesis of arrythmias. In speaking of treatment, Mr. Mariani first illustrated auricular insufficiency and the pathogenetic treatment of arrythmias, then the insufficiencies of the left ventricle in a state of hypertension, and finally, the insufficiency of the right ventricle, which he divided into three categories: absolute insufficiency, evident, relative insufficiency, and latent relative insufficiency. He illustrated the great advantages which can be obtained in these forms by Swedish physical treatment,—either passive in the serious conditions, or progressively resistant to educate the heart and increase the forces of resistance and reserve.

Mr. Mariani expressed his belief that the example of Milan should be followed in other medical centres in order to make available to all physicians the current scientific information about conditions of the heart.

University of Buffalo Alumni Association.—At the annual business meeting of the Alumni Association of the Medical Department of the University of Buffalo, the following officers were elected for the ensuing year:

President, John A. Stapleton; First Vice-President, Charles B. Kibler; Second Vice-President, William C. Heussy; Third Vice-President, James H. Carr; Fourth Vice-President, Mary O'Malley; Fifth Vice-President, John C. Lappeus; Secretary, A. H. Aaron; Treasurer, Harry N. Feltes; Trustee, William F. Jacobs; Chorister, Norman L. Burnham; Chairman of Executive Committee, Harry R. Trick; Executive Committee, Theodore M. Leonard, Henry J. Mulford.

Return to United States of Base Hospital No. 21.—With the cessation of hostilities the work of the overseas medical units, though considerably lessened, was far from completely finished and has required in many instances the retention for several months longer of a large part of the enlisted personnel. Among the recent arrivals in the United States, after twenty-three months of successful service, was Base Hospital No. 21, made up of the faculty of the Washington University School of Medicine, St. Louis, which landed in New York on April 20, 1919. This unit, commanded at first by Major Fred T. Murphy and later by Lieutenant-Colonel Borden Veeder, was in the first thousand troops to go overseas from the United States. During the eighteen months of their stay in Rouen, the members of this Unit took care of over 62,000 patients. For a considerable portion of its service, Base Hospital No. 21 was attached to the British forces, and part of the Unit, under command of Major W. B. Clopton, took part in the St. Mihiel and Argonne engagements as Mobile Hospital No. 4. Base Hospital No. 21 established for itself a splendid record and many of its members were selected for special work. Lieutenant-Colonel Walter Fischel was in charge of the medical service;

Miss Jane Stimson became head of the Nurses' Corps of the American Expeditionary Forces and has remained in France; Colonel Nathaniel Allison was appointed orthopedic consultant of the American Expeditionary Forces. Major Sidney Schwab was placed in charge of Hospital No. 117 for war neuroses. Colonel Opie was detached for coöperative work with Colonel Strong in his trench fever research, and later was placed in charge of the pneumonia command in the Surgeon-General's office. Colonel Murphy later was appointed medical and surgical director of the American Red Cross in France.

BOSTON AND MASSACHUSETTS.

WEEK'S DEATH RATE IN BOSTON.—During the week ending July 5, 1919, the number of deaths reported was 155 against 201 last year, with a rate of 10.15 against 13.36 last year. There were 21 deaths under one year of age against 28 last year.

The number of cases of principal reportable diseases were: Diphtheria, 45; scarlet fever, 27; measles, 33; whooping cough, 20; tuberculosis, 41.

Included in the above were the following cases of non-residents: Diphtheria, 2; scarlet fever, 1; tuberculosis, 3.

Total deaths from these diseases were: Diphtheria 1; whooping cough, 1; tuberculosis, 15.

Included in the above were the following non-residents: Diphtheria, 1.

During the week ending July 12, the number of deaths reported was 218 against 210 last year, with a rate of 14.28 against 13.96 last year. There were 37 deaths under one year of age against 39 last year.

The number of cases of principal reportable diseases were: Diphtheria, 41; scarlet fever, 22; measles, 24; whooping cough, 12; tuberculosis, 31.

Included in the above were the following cases of non-residents: Diphtheria, 5; scarlet fever, 6; tuberculosis, 5.

Total deaths from these diseases were: Diphtheria, 4; measles, 1; whooping cough, 4; tuberculosis, 25.

Included in the above were the following non-residents: Tuberculosis, 1.

HEALTH REPORT OF WORCESTER.—The annual report of the Board of Health of Worcester, Massachusetts, records the vital statistics, complaints, and communicable diseases of the past year. The total number of deaths throughout the year was 3,759, or a mortality of 20.5 per thousand, the largest in the history of Worcester. With the exception of deaths from influenza and pneumonia, the death rate was unusually low; excluding deaths at both State hospitals, it was 18.27; excluding non-residents, it was 17.4.

The Bacteriological Department has examined 2,885 cultures of diphtheria, 1,180 specimens of sputum, 118 Widal tests for typhoid bacilli, and four malaria tests. There were reported during the year, 168 cases of scarlet fever, 25 of typhoid fever, 166 of diphtheria, 336 of pulmonary and laryngeal tuberculosis, and 6,884 of influenza and pneumonia. Two hundred and eighty-five persons were vaccinated by the Department. A total number of 1,459 visits were made by the school nurses during the year.

The report of the Belmont Hospital shows that a total of 529 patients suffering from scarlet fever, diphtheria, and influenza were admitted during the year. In Putnam Ward for advanced tuberculosis, 225 patients were treated, and 79 patients were registered in the Out-Patient Department.

RHEIMS HOSPITAL FUND.—The Boston endowment fund for beds in the Rheims Hospital, established by the New England Branch of the American Fund for French Wounded, is now complete. The fund has reached a total amount of $151,023.60.

BROCKTON INFANT MORTALITY RATES.—The infant mortality rate in Brockton is unusual, for the fact that the rate for the native group is 101.5 and for the foreign group, 92. An investigation has been made to discover the effect upon infant mortality of various economic, social, and physical factors. Comparison of the differences in infant mortality rates between the children of the native and foreign born in other cities serves to emphasize the peculiar record of this manufacturing community. Figures compiled show that the rate for the foreign-born group is greater than that for the native group by 55 points in Manchester, by 37 in Waterbury, and by 67 in Johnstown.

It is believed that the surprising difference

in favor of the foreign born in Brockton may be explained partially by the fact that the wages paid to skilled workers are high enough to permit them to live in comfortable circumstances. There is no problem of excessively poor housing conditions in Brockton, and there are no great numbers of foreigners of extremely low economic status with a correspondingly low standard of living.

Franklin District Medical Society.—At the bi-monthly meeting of the Franklin District Medical Society, held on July 15, a dinner and reception was given to members of the Society who have returned from service in the United States Army and Navy. Among the speakers were Dr. Charles Upton, Dr. Charles Canedy, Dr. Alfred Johnson, Dr. F. A. Millett, Dr. John Mather, Dr. Roscoe Philbrick, Dr. Charles Molin, and Dr. Howard Kemp.

Greater Boston Dental Society.—The 18th annual dinner of the Greater Boston Dental Society was held recently in Boston, with more than 40 members present. The meeting was arranged by the following committee of physicians: Dr. S. Krensky, chairman; Dr. I. Finklestein, Dr. S. Burke, Dr. H. Stearns, and Dr. A. J. Cushner.

Massachusetts Tuberculosis League.—It has been reported that the executive committee of the Massachusetts Tuberculosis League, a voluntary organization of which 80 anti-tuberculosis societies in all sections of the State are members, is in favor of prolonging the daylight-saving plan, in the belief that the additional amount of sunlight and fresh air which may be gained thereby is a means of prevention and cure of tuberculosis. A resolution to this effect has been passed and forwarded to the President and to the National Tuberculosis Association.

Renomination of Dr. J. Armand Bedard.—Dr. J. Armand Bedard of Lynn has been nominated a second time for the office of medical examiner of Essex County. The first nomination was made by the Governor on June 18. Although the Executive Council refused to confirm the appointment of Dr. Bedard, no reasons were given, and no question about his ability was raised.

State Infirmary at Tewksbury.—The 65th annual report of the State Infirmary at Tewksbury shows that nearly 6,000 people have been cared for during the year. There have been 147 births and 662 deaths at the institution. Because of the absence of physicians in war service, the work has been conducted with the smallest possible number of physicians. There were 14 cases of diphtheria, 21 of typhoid fever, 42 of chicken-pox and 78 of measles; 821 cases of pulmonary tuberculosis were treated. The department for the insane admitted 92 new patients, and cared for a daily average of 720.49 patients. During the influenza epidemic, 2,188 patients were inoculated with "Leary vaccine," after which the spread of the disease is reported to have ceased within a short time. Seventy-five members from all departments have been in active service during the war. The nursing department and the training school for nurses have been maintained throughout the year with great difficulty, owing to the shortage of nurses; seventeen nurses were graduated.

Boston University School of Medicine.—We regret that it was erroneously stated in a previous issue of the Journal that at the annual meeting of the Alumni Association of the Boston University School of Medicine, held on June 2, plans were discussed for changing the system of teaching in that school. No changes are contemplated at this time.

NEW ENGLAND NOTES.

European Relief Funds.—On July 11, the totals of the principal European Relief funds of New England reached the following amounts:

French Orphange Fund	$504,612.41
Italian Fund	294,230.66
Polish Fund	130,977.58

Obituaries.

NATHANIEL BOWDITCH POTTER, M.D.

Dr. Nathaniel Bowditch Potter died on July 5 at a hospital in San Francisco, California. Dr. Bowditch had been ill for several years, finally succumbing to tuberculosis. He was born in Keeseville, New York, on Decem-

ber 25, 1869, the son of George Sabine and Mary Gill (Powell) Potter. He was graduated from the College of the City of New York in 1888, and from Harvard in 1890, and from the Harvard Medical School with the degree of M.D., four years later. For many years Dr. Porter engaged in a wide practice as physician and surgeon in New York City. He had been professor of the clinical department at the College of Physicians and Surgeons of Columbia University, and had served as chief of the medical department at St. Mark's Hospital, as consulting physician to the French Hospital, to the New York Throat, Nose, and Lung Hospital, and to the Central State Hospital.

Dr. Potter had edited several medical editions of Sahli's "Diagnosis," and the first and second editions of Ortner's "Therapeutics." He was a member of the New York Academy of Medicine, the American Medical Association, the New York State and County Medical Association, and the Harvard Medical Association. He was an Officier de l'Instruction Publique and corresponding member of the Société Médicale des Hôpitaux de Paris. He was also a member of the University Club. In 1908, Dr. Potter married Miss Mary Sargent of Brookline.

HENRY TUCKER MANSFIELD, M.D.

Dr. Henry Tucker Mansfield died on July 6, at the age of 81. He was born in Boston on February 2, 1838, the son of John Tucker Mansfield, a merchant who was United States consul at Parrambues, Brazil, from 1820 until 1836, and of Eloise Adeline (Story) Mansfield, who was the daughter of Dr. Elisha Story of Marblehead, a member of the historic "Boston Tea Party" of Revolutionary times. Dr. Mansfield received his education in the public schools in Salem and then attended the Harvard Medical School, from which he received his M.D. degree in 1869, and the same year he began active practice in Boston. On October 5, 1903, he was married in Needham to Edith (Mae Bigelow.

In 1874 he removed to Needham, where he served as a member of the board of health and as town physician. In Civil War days Dr. Mansfield was acting assistant paymaster of the Navy. He retired from practice several years ago. He was a member of the American Medical Association, the Massachusetts Medical Society, and the Norfolk District Medical Society.

DANIEL JOSEPH BROWN, M.D.

Dr. Daniel Joseph Brown died of acute Bright's disease at his home in Springfield, July 8, 1919, aged 58 years.

The son of George and Helen Brown, he was born at Milford, Mass., January 28, 1861. He was educated at St. Lawrence Academy and at Harvard Medical School, where he took his M.D. in 1886. After three years of hospital and post-graduate work, he settled in Springfield, becoming, later, visiting surgeon to the Mercy and Springfield hospitals. In April, 1915, he was appointed a member of the Springfield police commission and held membership in the commission at the time of his death, having been at one time chairman. He was a member of the Springfield Academy of Medicine, the American Medical Association, the Massachusetts Medical Society, and the American College of Surgeons. In 1891, he married Mary E. Marden of Springfield. She survives him.

Miscellany.

RÉSUMÉ OF COMMUNICABLE DISEASES FOR MAY, 1919.

GENERAL PREVALENCE.

For the month of May there were 7,476 cases of communicable diseases reported, as compared with 16,005 for the same month in 1918. Tho total case rate per 100,000 population for May, 1919, was 190.6; the case rate for May, 1918, was 415.8.

Diphtheria.—There were 559 cases of diphtheria reported during May, 1919, as compared with 663 for the same month in 1918, giving an incidence per 100,000 population of 14.3 and 17.2 respectively.

Influenza is still decreasing, 406 cases being reported this month as compared with 1,069 last month.

Measles again showed a drop as compared with the same month last year; there were 1,307 cases reported during May, 1919, while 6,335 cases were reported during the same month last year. This decrease from the reported cases of 1918 has appeared each month this year.

Scarlet Fever showed an increase over the same month in 1918, the cases reported being 805 and 487 respectively. The case rate per 100,000 population for May, 1919, was 20.5 as compared with 12.7 for May, 1918.

Typhoid Fever showed a distinct decrease in reported cases; 42 cases were reported during May, 1919, and 70 during May, 1918.

Venereal Diseases.—The number of cases of gonorrhea and syphilis reported during this month showed a slight increase over the corresponding month of 1918.

During May, 1919, 1174 cases were reported, 1121 were reported during May, 1918. The newly reported cases of gonorrhea were 812 and of syphilis 362. This is a moderate increase over the reported cases for the first two months this year.

Whooping Cough also showed a decrease in reported cases, there being 471 cases reported this month as compared with 1,001 for May, 1918.

OUTBREAKS.

Twenty cases of measles were reported by Groton on May 16. Investigation showed several undiagnosed cases at school, and absentees sick at home without medical attention. Better reporting of cases and inspection of schools by physicians brought results.

Of the eight cases of smallpox reported, five were traced to the outbreak on the schooner *Hesperus*, previously reported.

RARE DISEASES.

Actinomycosis was reported from Taunton, 1.

Anterior Poliomyelitis was reported from Ipswich, 1.

Anthrax was reported from Chelsea, 1; and Salem, 1; total, 2.

Dog-bite requiring anti-rabic treatment was reported from Brockton, 1; Groton, 2; and Lawrence, 2; total, 5.

Epidemic Cerebrospinal Meningitis was reported from Belmont, 1; Boston, 6; Brockton, 1; Cambridge, 1; Camp Devens, 1; Everett, 2; Fall River, 2; Gloucester, 1; Haverhill, 1; Lynn, 2; North Adams, 1; Northboro, 1; Quincy, 2; Weymouth, 1; Winthrop, 1; and Worcester, 1; total, 25.

Leprosy was reported from Boston, 2.

Malaria was reported from Boston, 1; Northbridge, 1; and Winthrop, 1; total, 3.

Pellagra was reported from Boston, 1; and Foxboro, 1; total, 2.

Septic Sore Throat was reported from Boston, 6; Brookline, 1; Framingham, 1; Haverhill, 1; Leominster, 1; Lynn, 1; Newbury, 4; Newburyport, 8; Newton, 3; Saugus, 1; Sharon, 1; Tewksbury, 1; Walpole, 3; Waltham, 3; and Watertown, 1; total, 36.

Smallpox was reported from Cambridge, 1; Edgartown, 1; Gloucester, 2; Ludlow, 1; and Springfield, 2; total, 7.

Tetanus was reported from Easthampton, 1; Malden, 1; and Pittsfield, 1; total, 3.

Trachoma was reported from Boston, 6.

Correspondence.

SUSPENSION OF REGISTRATION CERTIFICATES IN MEDICINE.

Boston, July 10, 1919.

Mr. Editor:—

Will you please call the attention of the readers of the JOURNAL to a very pernicious piece of legislation passed by the Legislature of the Commonwealth and approved by the then Governor of Massachusetts, during the year 1917?

This act is entitled "General Acts of 1917, Chap. 218, An Act Authorizing Boards of Registration to Suspend and Cancel Certificates of Registration." Under this act, the State Board of Registration is summoning before it, upon unjust complaints of irresponsible persons, reputable physicians, and compelling these physicians to defend themselves of the most absurd allegations on pain of losing their licenses to practice medicine in the State.

It is a matter of great importance to the medical profession as a whole, and I hope that all members who see this letter will at once write to their representatives in the General Court and urge the repeal or amendment of this act at the next session of the legislature.

Respectfully yours,
JOHN T. WILLIAMS.

APPOINTMENTS.

The Board of Scientific Directors of The Rockefeller Institute for Medical Research announces the following promotions and appointments:

DR. HAROLD L. AMOSS, hitherto an Associate in Pathology and Bacteriology, has been made an Associate Member.

DR. OSWALD T. AVERY, hitherto an Associate in Medicine, has been made an Associate Member.

The following have been made Assistants:

MISS CLARA J. LYNCH (Pathology and Bacteriology).

DR. WARO NAKAHARA (Pathology and Bacteriology).

The following new appointments are announced:

DR. HOMER F. SWIFT, Associate Member in Medicine.

DR. FRANCIS G. BLAKE, Associate in Medicine.

DR. RAYMOND G. HUSSEY, Associate in Pathology and Bacteriology.

DR. J. HAROLD AUSTIN, Assistant in Medicine and Assistant Resident Physician.

DR. ALBERT H. EBELING, Assistant in Experimental Surgery.

DR. FERDINAND H. HAESSLER, Assistant in Pathology and Bacteriology.

DR. THORSTEN INGVALDSEN, Assistant in Chemistry.

DR. CHARLES W. BARRIER, Fellow in Pathology and Bacteriology.

DR. J. JAY KEEGAN, Fellow in Pathology and Bacteriology.

DR. PHILIP D. MCMASTER, Fellow in Pathology and Bacteriology.

DR. ALPHONSE R. DOCHEZ, hitherto an Associate Member in Medicine, has accepted an appointment as Associate Professor of Medicine in the Medical Department of Johns Hopkins University.

DR. ARTHUR L. MEYER, hitherto an Associate in Physiology and Pharmacology, has accepted an appointment as Associate in Physiology in the School of Hygiene and Public Health, Johns Hopkins University.

DR. HOWARD A. STREETER, State Health Officer for the Berkshire District, was appointed, June 1, 1919, Chief of the Subdivision of Venereal Disease, State Department of Health.

RECENT DEATHS.

MAJOR VICTOR CLARENCE VAUGHAN, JR., was accidentally drowned in France, on June 10, while on duty with the American Expeditionary Forces. Major Vaughan was born in Ann Arbor, Mich., in 1879. He was Associate Professor of Preventive Medicine and Assistant Professor of Medicine in the Detroit College of Medicine and Surgery, and the author of valuable contributions to pathology and bacteriology.

DR. AMOS J. GIVENS, President of the Givens Sanitarium in Stamford, Connecticut, died at that institution, on July 7, of heart disease. Dr. Givens was sixty years of age.

DR. ALFRED WILLIAM BARR, of Lawrence, died in the United States service, at Fort Slocum, N. Y., Oct. 8, 1918, aged 30. He was a Fellow of The Massachusetts Medical Society.

DR. ABRAHAM JACOBI died, on July 10, at his home on Lake George. Dr. Jacobi was educated in Germany, but received honorary degrees from the University of Michigan, Columbia, Yale, Harvard, and Jefferson Universities. From 1851 to 1853 he was held "in detention" in Berlin and Cologne because of his connection with the German revolutionary movement. After his release he came to the United States and began practicing in New York, specializing in the diseases of children.

WILLIS OLIVER BARNEY, M.M.S., died at Boston, June 25, 1919, aged 30, as the result of an automobile accident. He was a graduate of Tufts College Medical School in 1912. He made a specialty of otology, laryngology, and rhinology.